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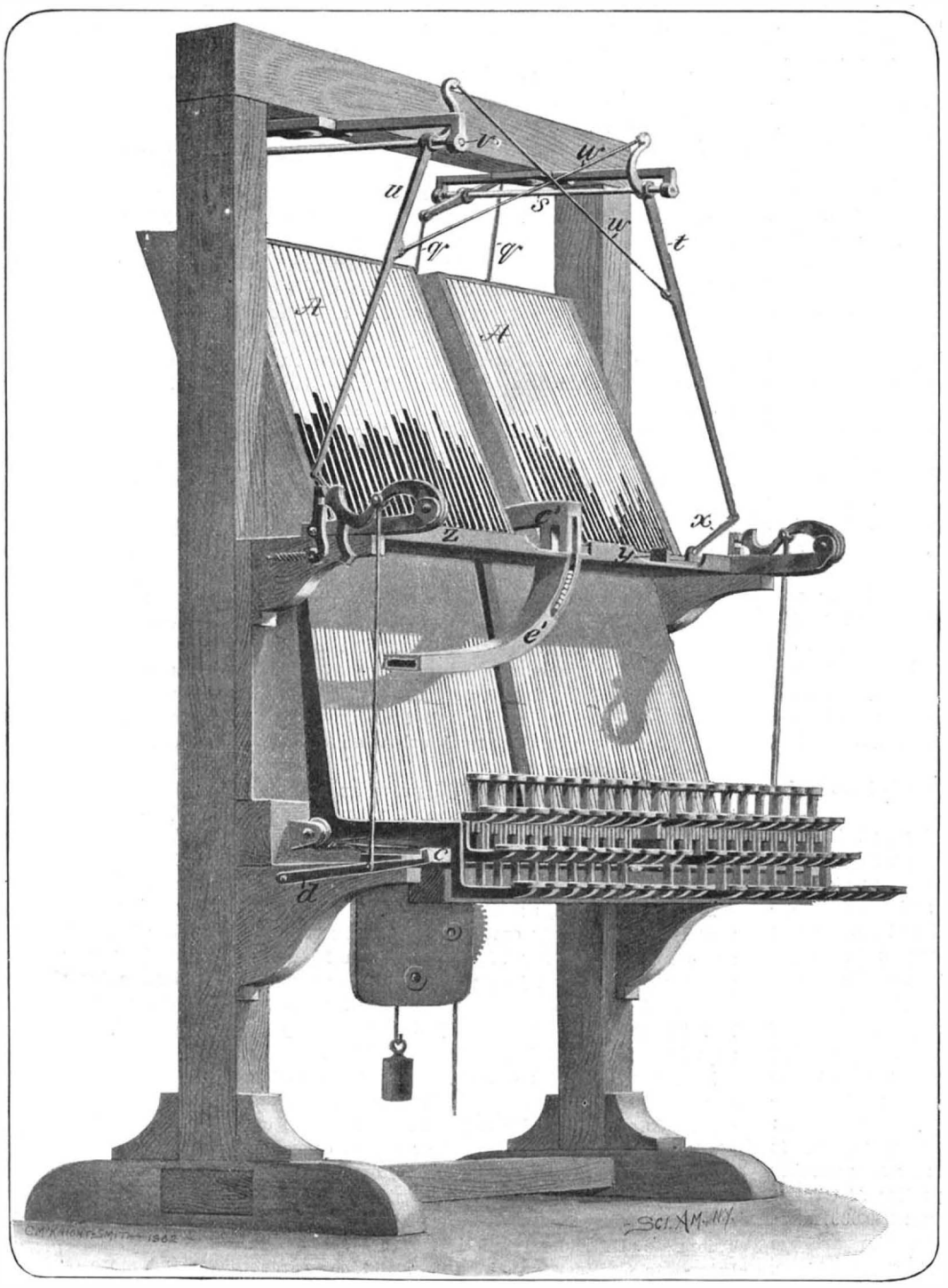
THE INVENTIONS OF DR. WILLIAM CHURCH—THE FIRST PATENTED TYPE-CASTING AND COMPOSING MACHINE.

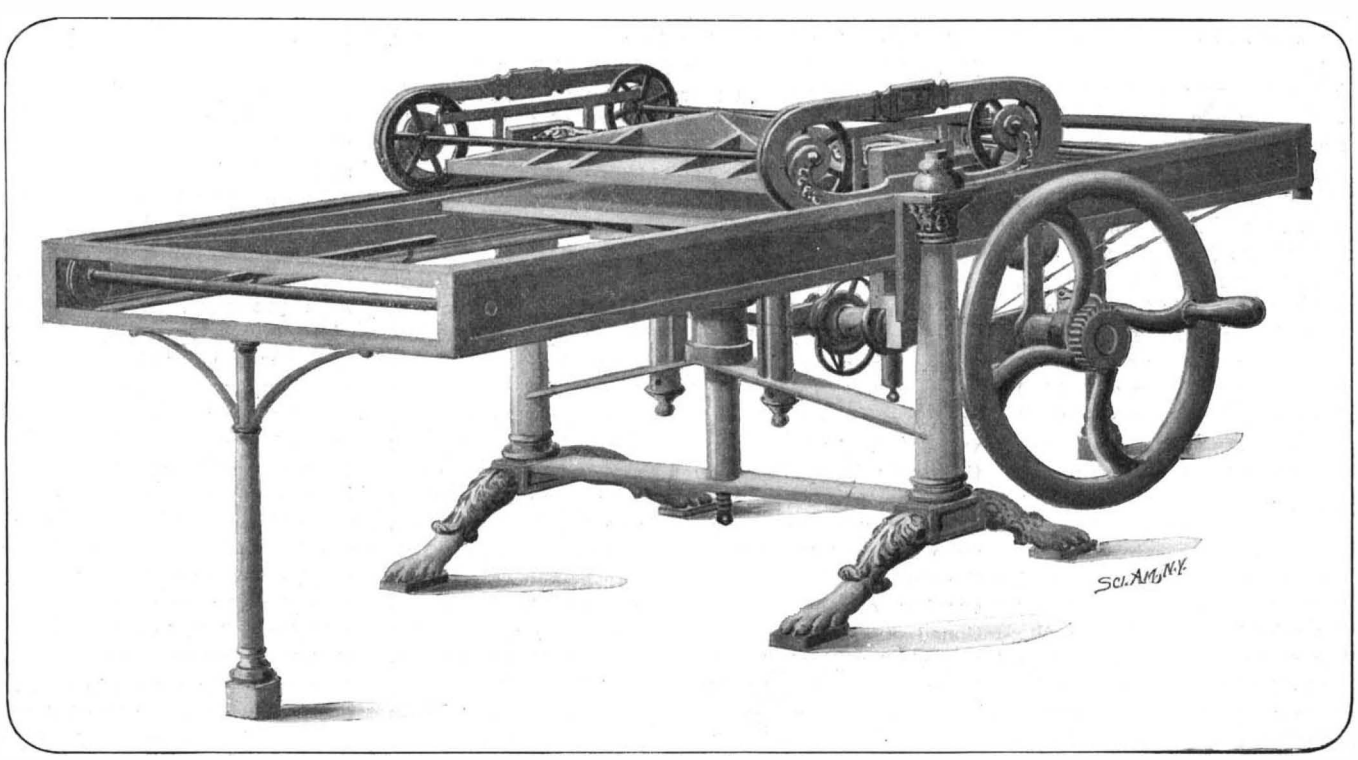
In its issue of May 17, 1823, the American Advocate and General Adviser published, under the title "Is This Not a Hoax?" the following item:

"Dr. Church is now at Birmingham (England) preparing his new printing press. The compositor has only to sit down at this curious piece of mechanism as he would to a piano-forte, and as he strikes the keys the types all fall into their proper places with a velocity that keeps pace with the most rapid speaker. The form having been worked off, the type moves into a melting pot, from which it is returned, recast in its original state, without diminution of material, and then distributed into the case quite new. One of these presses placed at the bar of the House of Commons would always insure a correct report of the debate. Dr. Church, the inventor, is a native of Boston, New England."

The modern printer may recognize in this vague description the prototype of the machine which has come into such general use within recent years. Although it was not the first invention of its kind, Church's device is interesting from a historical point of view, for the reason that it was probably the first patented device for casting and composing type. To the credit of American ingenuity be it said, that William Church was a Yankee. Strange to say, however, he did not procure a United States patent for his interesting inventions, but for some reason contented himself with an English patent only. He seems to have invented his machine in 1821; for in that year he was in England for the purpose of introducing a new press which he had devised. One year later he received his English patent, in which he describes three distinct machines—a machine for casting printing types, and also for arranging them in boxes of letters, so that the types of the same denomination are placed side by side in ranges; a machine by which these individual types are selected from the ranges and composed into words and sentences; and a press for printing and delivering the sheets into a pile.



THE FIRST PATENTED TYPESETTING MACHINE. DATE 1822. INVENTED BY DR. WILLIAM CHURCH, OF BOSTON, MASS.



CHURCH'S PRESS FOR PRINTING AND DELIVERING SHEETS IN A PILE. PATENTED 1822.

The type-founding machine, in some of its features, seems strangely modern. The molten metal was contained in a trough or box extending across the machine, and flowed from this trough or box into the type mold *B*, which was provided with grooves intended to form the body of the letter. The matrices were placed in a groove in the matrix bar. The metal trough or box was supplied by a fountain *D*. The trough or box being furnished with fluid metal, a plunger contained in a casing F^1 was forced into it, thereby driving the metal into the molds. A hand-wheel *G* gave motion to a shaft *H*, upon which a cam-wheel *I* was fixed. This cam-wheel was of peculiar construction, and its various protuberances were the means whereby the casting was, to a large extent, effected. The wheel was provided with an elevated cam *c* on its periphery, which cam was situated, when the machine was at rest, under the friction roller at the end of the lever *J*, by which the plunger was held up. As soon as the wheel *I* had turned sufficiently to slide the cam *c* from under the friction roller of the lever *J*, the plunger was instantly drawn down by the weight *K* attached to the lever *J*. In its descent, the plunger drove the molten metal into the type mold. When the wheel *I* had revolved some distance further, a cam *d* on the periphery came into contact with the friction roller at the end of the lever *L*, and lifted it. At the opposite end of the shaft which carried the lever *L* was a shorter lever which, by means of a connection with the type mold *B*, shifted the moldbar endwise for the purpose of cutting off the communication of the mold with the fluid metal, and also of bringing the molds under certain punches. In this stage of the operation, it became necessary to unlock the matrix-bar *C*. This was done by the further progress of the wheel *I*, which brought the cam *e* on the inside of wheel *I* in contact with the friction roller of the lever *M*, thereby shifting the lever sidewise and causing the bar *N* (attached to the opposite end of the lever) to be so far shifted laterally as to unlock or withdraw wedges formed on the bar, from sockets or slots of loops which held the matrices in contact with the molds. By this means the matrix bar was allowed to descend about an eighth of an inch, so as to withdraw the matrices from the cast types. The matrix bar *C* was now to be drawn forward from under the types in order to clear the way for their descent into the boxes, where they were ranged. This was

(Continued on page 116.)

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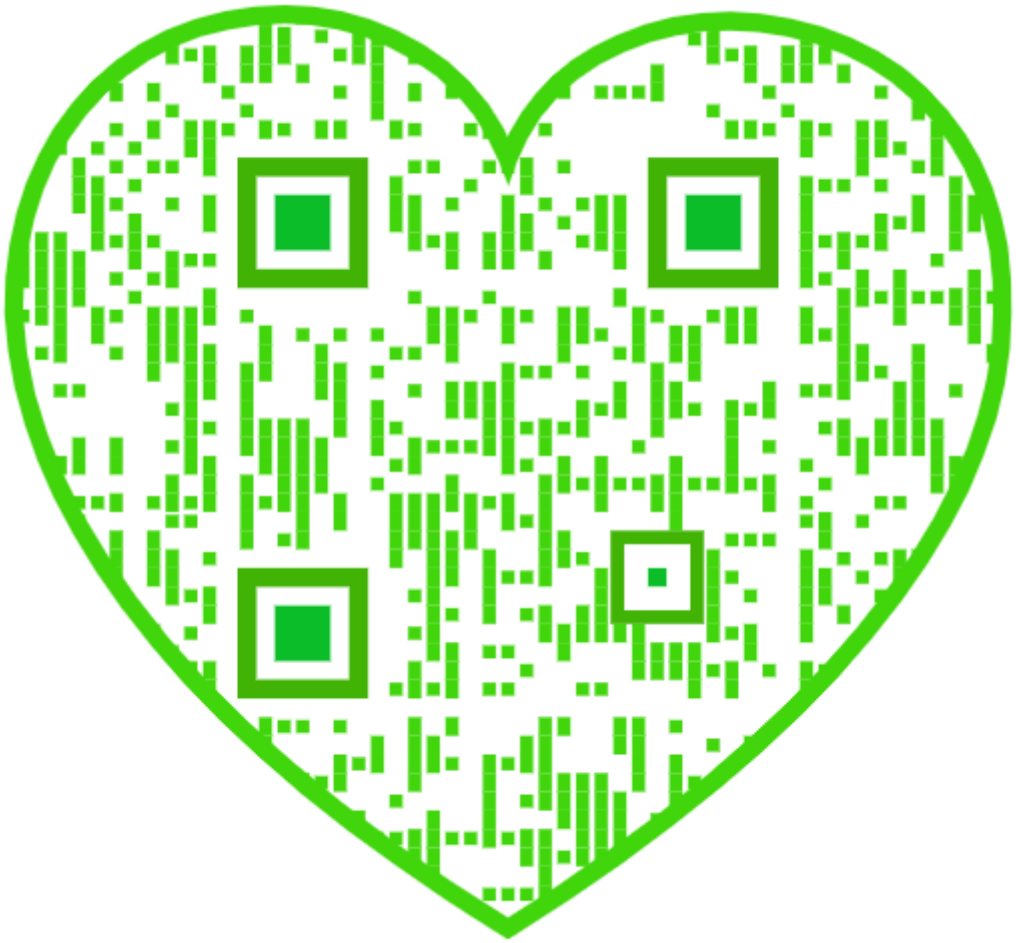

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NEW YORK, SATURDAY, FEBRUARY 14, 1903.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

"HOW MUCH, THEN, IS A MAN BETTER THAN A SHEEP?"

Matt. xii., 12.

The Editor is not about to preach a sermon. He is merely going to indulge in a few reflections on the cheapness of human life, as shown by the wholesale slaughter of passengers that is occurring day by day on our railroads.

It will not be a pleasant reverie; certainly it will not be flattering to our sense of national esteem; and it must needs make the most thoughtful of us, and the truly patriotic among us, realize that with all our boasted advancement in the useful arts of modern life, there are certain respects in which we are a long way behind some of those older countries, which we are apt to think we have left far behind us in all things that affect the comfort, safety, and sanctity of the life of the individual citizen.

Some time ago the British Board of Trade was able to announce that during a period of twelve months not a single passenger had been killed on the railroads of Great Britain. Since then another three months has passed without a fatality, making a straight record of fifteen months' operation of the most crowded railroad system in the world without a single loss of life.

Here, in the United States, our railroads have killed 77 passengers in fifteen days!

In cases of such astounding disparity as this there are usually to be found some mitigating, explanatory conditions. Let us then ask, are there any elements in American railroading that will satisfactorily explain why it is that the British railroad system can carry its teeming millions of passengers in fifteen consecutive months without killing one, while American railroads cannot carry a fraction of the number in fifteen consecutive days without killing 77 of them?

We have to confess that, so far from there being any mitigating circumstances, the more we look into the question the more inexcusable does our own shocking death list appear; and for the following reasons: First, the total number of passengers carried is greater in Great Britain; second, this greater number is handled upon one-eighth as many miles of track—24,000 miles in Great Britain as against 200,000 miles in the United States; and, thirdly, the average speed and the frequency of the trains is greater there. So that the slaughter that is going on is actually less excusable than the mere figures—and Heaven knows they are bad enough—would show. For with a smaller total number of passengers and trains, and in spite of the fact that they are spread over eight times as many miles of track, we kill 77 in 15 days while they kill not one in 15 months.

But why this appalling difference; and what, if any, shall be the remedy? Perhaps the trouble is that we have not as yet arrived at a proper estimate as to by how much a man is better than a sheep. Some people have been trying to solve the problem, and we believe that it is a fact that an enlightened legislature once put the difference at $5,000, or to be more exact $4,995—a fair average market value for a sheep being, we are told, about $5. It is true the correctness of this legislative estimate has been called in question, and twelve of the fellow citizens of a recent railroad victim have set the worth of a man at $60,000—an appreciation in value which has been sustained recently in one of the highest courts of appeal. There is no doubt that this higher valuation will go a certain distance in reducing the death rate on railroads; but it will never teach us to run our railroads 15 months without killing anybody.

We recently presented this comparison of railroad fatalities to the chief engineer of one of the leading railroads entering this city, who is a specialist on the question of block signaling, and asked him to explain the 77 fatalities, fully one-half of which, by the way, occurred on roads that were equipped with as fine a block signal system, and perhaps a better, than any in Europe. In his prompt reply he put his hand at once on the weak spot: "The different results are to be explained by a difference in national temperament—here, we take chances." He was right; our engineers do take chances; they interpret signals to please themselves; run past them, and—kill 77 passengers in 15 days.

But what are we to do? We cannot change "national temperament." True; but we can at least curb it, and we can do so in the case of the railroad engineer by extending the automatic principle, so that if he does not shut off steam for green lights and put on air for red lights, it will be done for him.

Let us place two levers on the engine and two corresponding trips on the track, one within sighting distance of the green and the other within sighting distance of the red signal. Let the green trip register with a lever that shuts an auxiliary throttle valve near the smokebox; let the red trip register with another that will set the emergency brake. Then should the engineer fail to shut off steam and let his engine coast on approaching the distant green signal, it will be shut off for him; and if he fail to set the brakes on sighting the home or red signal, the trip will open the train pipe. The levers could be so arranged that if the engineer manipulated his throttle and brakes in accordance with the signals, there would be no connection made between the trips and the engine. The suggestion as to automatic air-brake connections with the red signal was made several years ago, and it is excellent; the green light trip acting on the throttle is a logical extension of the idea.

"But," says the railroad official, "by the use of an absolutely automatic system you would destroy that element of watchfulness which it is our desire to cultivate in our engineers. They would become careless and would cease to watch for the signals. Then, should the signals fail, the chances of accident would be greater than before." Very good; then let the roundhouse foreman set a seal upon the automatic levers on the locomotive before it starts on its trip; and let it be a cast-iron law of the railroad that if an engineer come back with the green signal seal broken, he will be fined thirty days' pay, and that if the red seal be broken he will lose his job, and be blacklisted from Maine to Florida and from New York to the Pacific coast.

Here is a system that would prove an almost absolute preventive of collision, and that, incidentally, would produce in the first brief month of its operation a set of engineers who for alert vigilance would be hard to match.

But to extend this method to all the block systems would be enormously costly. True; but not so costly as to keep on killing 77 passengers in 15 days; especially if, as recent jury verdicts are suggesting, the people of the United States are waking up to the belief that the "how much" between a sheep and a man is some big multiple of 4,995 dollars.

Furthermore, we must remember that, to-day, of our 200,000 miles of tracks, only 25,000 miles, or one-eighth, is equipped with a block signal system of any kind. And here we find another potent cause of our perpetually-recurring railroad horrors. Train dispatching by telegraphic orders assists in keeping up the frightfully high average of railroad disasters. Take note of Accident Bulletin No. 5 just issued by the Interstate Commerce Commission, which records that in the three months ending September 30, 1902, 263 persons were killed and 2,613 injured in railroad disasters. At that rate, in the 15 months of which we have spoken, the total number of killed would run up to 1,315 and the injured to over 13,000.

And to think that it is all preventable! Moreover, just as soon as we really understand how infinitely much a man is worth more than a sheep, it *will* be prevented—if not by the initiative of the railroads, then by legislative act compelling the application of a direct, engine-controlled, block signal system to every one of the 200,000 miles of track.

GERMAN-AMERICAN WAR GAME.

The series of war games now being played at Portsmouth, between representatives of the American and German navies, has passed through the first critical stage. The close of this stage was an important battleship action in the Philippines, in which the American fleet, owing to numerical inferiority, was practically wiped out. As those of our readers who are following this very interesting series in the SUPPLEMENT are aware, at the opening of the war game the various contending fleets and squadrons on the checker boards were assumed to be in the exact positions in which the fleets of the two nations were at the date of the opening of the game. In the Pacific were stationed only four of our battleships, the 'Wisconsin," "Oregon," "Illinois," and "Kentucky," with the monitors "Monterey" and "Monadnock." Immediately upon the declaration of war the Germans dispatched, post haste, to the Philippines a battleship fleet made up of the very latest of their new battleships that have been completed within the last five years, all ships of 18 knots speed. The principle of concentrating in superior force upon some chosen weak spot of the enemy's line is a sound one, and is unquestionably the course which would be followed by Germany in a state of actual war. The United States players, to meet this move, wished to dispatch the North Atlantic fleet to Manila, but were prevented by the umpires from doing so on the ground that American public opinion along the Atlantic coast would not allow the seaboard to be left in such an undefended condition. The umpires demanded two or three weeks' delay of the North Atlantic squadron until a system of patrol by monitors, etc., could be established. Even with this loss of time, however, the situation in the Philippines might have been saved had the Panama Canal been built and in operation; for it would have been possible to send additional battleships to Manila in time to provide an equal United States fighting force, if not a preponderance of strength, for the great naval battle that was impending off Manila. The full significance of these strategical lessons of the war game will be appreciated, when it is remembered that the war game at Portsmouth is being fought out with absolute impartiality by British officers, who take up the opposing fleets simply with a view to training themselves in naval tactics and strategy. Hence, to everyone who takes an intelligent interest in naval affairs in general, and is therefore capable of forecasting the trend of events in case of a German-American war, it will not be surprising to learn that the three great lessons of the war game thus far developed are: first, that the far-distant Philippines are our most vulnerable point, and therefore the probable seat of attack in our next naval war; second, that if we are to render our navy fully efficient to cope with the new situation opened by the possession of the Philippines, we must dig the Panama Canal, and do it with all possible dispatch; and thirdly, that the United States fleet, at its present strength, is totally inadequate to cope with the larger series of operations now demanded of us as a colonial power.

After the defeat of the American fleet the German troops disembarked from the transports and made an assault on Manila which was repulsed, and this repulse, coupled with the advent of the American North Atlantic fleet, led to the re-embarking of the troops and the retreat of the German fleet to its naval base at Kiao Chau, China. Meanwhile, the second German battleship fleet, which crossed the Atlantic, captured Havana, and proceeded to recoal and refit, while the American fleet concentrated at Key West; so that the situation to-day consists in the juxtaposition of two opposing fleets: a German Pacific fleet in Kiao Chau Harbor blockaded by an equally powerful American fleet, and another German fleet in Havana Harbor watched by the American home squadron. In both hemispheres the combatants are so equally matched that the outcome is considered to be uncertain; but likely in any case to terminate the war.

A REFRACTORY PISTON NEEDED.

This title may cause a cynical expert to say to himself that pistons are generally refractory enough without calling for a new type, but that is as may be. The piston itself is a docile detail unless too much enforced by persons who follow tradition instead of exercising good judgment in the management of it. It is nothing more or less than a sliding, steam-tight partition in a cylinder; but to secure it against leakage various devices are used, most of them not only useless but harmful as well. Tradition teaches many that packing rings should be very wide and heavy, and provided with stiff springs behind having set-screws through them. Whoever achieved this last-named absurdity in a piston should have had special mention, for he could not have given much thought to the matter, or he would have seen that a spring with a set-screw through it was no spring at all, the elasticity and resiliency of it being destroyed.

In so far as the rings are concerned, the best practice now makes them as light as possible, in many cases dispensing with springs entirely. This type of piston is used on the heaviest kind of work, with very high pressures, in locomotive and torpedo-boat engines, and is wholly reliable against leakage. The advantages are that being relieved from abnormal and unnecessary pressure on its walls, the cylinder wears true and is not scored or cut by the packing rings. These last are called "snap rings," from the fact that they are sprung into the piston, having elasticity enough to go over its flanges and resume their form when they get into the grooves provided in the piston for them. In the early history of the steam engine great difficulty was experienced in getting true cylinders, for the lack of proper boring mills; and it in said that Watt, in alluding to this, wrote to a friend that they had at last succeeded in getting their cylinders so nearly correct in this respect that they "could not insert a crown piece between the packing and the cylinder walls anywhere." I do not know how thick a crown piece may have been in those days, a scant

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sixteenth of an inch possibly; but with such crude workmanship metallic packing rings were not possible, so recourse was had to hempen gaskets, driven in tightly between the piston and cylinder wall. It is not so very long ago that this method was still in use, for I have seen it put in in my day. With modern machine tools cylinders can now be perfectly bored, and as a result there is no occasion for jamming rings tightly into cylinders, a snug fit being all that is required; but it is necessary with this plan that the piston flanges should fill the cylinder, with no allowance for clearance, beyond that needed to let the piston move freely in the cylinder without touching it. Some very large cylinders and pistons have been made in this way with the best results, especially in the direction of revolutions per minute of the crankshaft. Friction being very much reduced, permits of increased piston speed.

Now that higher steam pressures are employed, and superheated steam is introduced, in many plants metallic packing of whatever description is giving more or less trouble, from the fact that hot metal bearing upon hot metal with any pressure at all does not behave satisfactorily; and designers are casting about for relief in this direction. Were it not for mineral oils with a high flash point, superheated steam engines would be impracticable, and even this makeshift, so to call it, does not wholly overcome the cutting of surfaces in contact. Gasoline and other explosive engines which generate high temperatures in their cylinders, experience the same trouble; and if it is possible to devise a piston which shall be immune from all derangements by excessive heat, a great advance will have been made. I am of the opinion that it can, and suggest, as one medium, plumbago rings of special design to suit the work required. As this substance is entirely neutral toward expansion and contraction, and capable of being molded into permanent forms suitable for packing rings, I do not now see any reason which would render plumbago rings impracticable. Confined as they would be in a cast-iron case, and not subjected to shock or jar, they should last a long time, with the possible exception of wear by attrition. This last would certainly give trouble for a short time until the cylinder became of mirror-like surface and polish; but when this is obtained, I believe that difficulties experienced with all metal rings would disappear for the work previously mentioned.

There is room for a great diversity of form and detail in the application of plumbago rings for packing, and the best and cheapest cannot be predicated; trial and error will show the fittest, and an experiment to determine this would cost so little that, from my point of view, it is worth a trial. E. P. W.

MR. WESTINGHOUSE ON AMERICAN METHODS IN STEEL-MAKING.

At a banquet given in London recently to a large company of British railway men, financiers, and scientists Mr. George Westinghouse made a noteworthy speech, in which he graphically compares European and American methods of steel-making.

Lord Kelvin had previously spoken of American methods. Mr. Westinghouse remarked that one of the English difficulties is inherent in an old-world, highly developed country. After a nation has worked prosperously for a long time, it opposes improvement or suggestion, thinking: Success with the old, discourages the introduction of the new. In America, however, the necessities have produced different results. Lord Kelvin said that England sent many men to America. Mr. Westinghouse acknowledged that, and added that it had also sent many ideas. The American patent records, patent decisions in infringement suits, show that among the references many inventions are of English origin, some of them containing ideas so complete, the wonder is that the inventions disclosed were not established fully and completely in your own land. These records seem to show that Americans and Englishmen have invented the same thing many times.

America has always been short-handed with regard to labor. Manufacturers have been obliged to find methods whereby one man may accomplish the work of two or three men as compared with your practice here. The works of the country have had the best men from Europe: Englishmen, Germans, French, everybody—skilled men, highly trained men, as well as laboring men; their experience has been combined with that of Americans, and thus there have been achieved results unattainable in a country like England, where there is more labor than can well be kept employed.

As an illustration of what has been accomplished by the use of electricity in a great industry, Mr. Westinghouse cited the Homestead Mills of the Carnegie Company. "Mr. Schwab," said Mr. Westinghouse, "is a genius in his way, particularly in the management of men. Mr. Carnegie believed in him, and if Mr. Schwab made a suggestion in regard to the use of new appliances, even if it involved the tearing down of an old mill and putting up a new one, the new one was ordered. What Mr. Schwab thought should be done, was done. As a result of such progressiveness we may see the splendid mills at Homestead where they produce with about 4,000 men three times as much steel as the Krupp works produce with 15,000 men. The results are simply wonderful. You can start there today, in a building containing steel-melting furnaces, and you will there see three men mounted on a car with the charging apparatus which is moved and operated by electricity. With a few movements of this ingenious contrivance three men charge twenty furnaces, which prior to the use of electricity, would have required the labor of over 200 men.

"You may go into the yard of the Homestead Mills where they pile the metal in stock. This yard is covered by a system of overhead cranes, and the result is that not only here, but in the mill, and in every other place, you may see great weights lifted and many undertakings going on without a single man exerting himself a bit."

Continuing, Mr. Westinghouse said: "I took some English friends to Homestead. Mr. Schwab, after guiding us through several departments, said: 'I will now show you where we turn out 750 tons of plate girders per day.' The mill was in the shape of an 'L.' We went into the short end of the 'L' where the furnaces were fed by natural gas, of course requiring no stokers. The end at which we entered had a rather low roof, and there was in sight a contrivance like a battering ram in front of the furnaces; two workmen were sitting down eating their dinners near by; no one else was present. I thought: 'Mr. Schwab has made a mistake, he has asked us to see a mill that is not in operation.' But we went through the mill, which was about 200 feet long; and suddenly we heard a rattle and then saw a truck approaching loaded with a big ingot. No one touched the truck or the ingot. The load came to a platform, the crane overhead dropped a pair of tongs and quickly put the ingot on the roller table, and as it moved to the great rolls, it was automatically kept in place. The adjusting screws of the rolls were turned by little electric motors, and not a man in that house did a bit of work. We went back to the furnaces. There was a fifteen-year-old boy seated in a little place called the 'pulpit.' He was able, merely by the movement of levers, to open at will any of the furnace doors and move the car along. And we saw this car come in front of a furnace and the charging machine approach, and take out of the open furnace a hot ingot which was dropped on the car and moved off to its work. There was this boy doing absolutely no hard work, and his mill was turning out 750 tons of steel plate each day. My English friends said: 'England has no chance in competition with such methods.' "

All this came about in America because of our necessities. There were not enough men to do the work. There was a premium in favor of those who could invent machines to work and thus supply the deficiency.

"At the Carnegie Mills," Mr. Westinghouse narrated, "we went to see three blast furnaces. They were making 1,800 tons of pig-iron in twenty-four hours. We saw only two or three men on a truck, which was moved automatically. These men were letting the ore run from shoots and mixing it in the required quantity, and when they had filled a truck, it was carried up and its contents dumped into a furnace whence it returned for another load. They were running the metal into an immense receptacle into which the metal from all three furnaces was mixed. From this place the metal was taken as required, put into a special tank, mounted on a car and taken to Homestead, two or three miles away, to be poured into the furnaces; one heating only was required."

LIGHTNING STRIKES THE NIAGARA POWER PLANT.

BY ORRIN E. DUNLAP.

The Niagara Falls Power Company suffered from a very remarkable disaster on the night of Thursday, January 29, when lightning struck the cables in the covered bridge that connects the generating station with the transformer house. This bridge is a stone structure having a slate roof, and crosses the inlet canal. At one end of it stands power house No. 1, in which 50,000 horse power is generated at a voltage of 2,200. The greater portion of this vast amount of current is conducted by the cables of 1,000,000 cm. capacity across the bridge to the transformer station. The bolt of lightning that came out of the January sky shortcircuited the cables on the bridge, and fire started. Before it was extinguished the interior of the bridge and transformer station, as well as the roof of both, had been badly damaged, while the cable connections across the bridge were totally destroyed. Water thrown into the transformer station by the firemen wet several of the huge transformers, and these were useless until dried out.

The destruction of the cables on the bridge caused no end of trouble, for it made impossible the distribution of the 50,000 horse power of the station, with the exception of the rotary service supply to the local electric lines, the arc light station, and the Natural Food Company. None of the generators were injured. However, the electric power supply of several of the tenants on the Power Company's lands, as well as that of the Buffalo and Niagara Falls Electric line, the Lockport-Buffalo line, and of industrial establishments in the Tonawandas, Lockport, and Buffalo, was wholly cut off. All the Niagara power sent to Buffalo passed across the cables on the burned bridge, in order that its voltage might be raised in the transformer station, and Buffalo was without Niagara power for its lighting and trolley service. It would have been hard to find a more vital point at which to attack this great and wonderful generating station. For a brief time the machines in both of the big power houses were shut down; but as soon as it was found to be possible, which was within an hour or so, the local trolley and lighting services were renewed.

While several of the industrial establishments at Niagara Falls were forced to shut down, the Buffalo and Lockport public fared much worse than Niagara Falls, because in Buffalo Niagara power enters into the lighting to a great extent, while the energy of Niagara is also used for the operation of the Buffalo and Lockport trolleys. All of the Buffalo manufacturing establishments that have come to use Niagara power remained idle on Friday, the day following the Niagara fire, as did also several in the Tonawandas. Lockport was also seriously inconvenienced. In Buffalo many of the papers use Niagara power in the operation of their presses, and its absence forced them to take their forms to other establishments that had a source of power. In Buffalo the International Traction Company greatly cut down the number of cars operated. Its storage battery and steam plant were brought into service.

The scene of the fire had not had time to cool ere the repair work was in progress. Night and day the men worked under the watchful inspection of Supt. Barton. By noon Friday the company was prepared to send 10,000 horse power to Buffalo, but as this was about to be sent out a short circuit occurred, delaying the transmission until about 4:30 P. M. Later an additional 5,000 horse power was furnished Buffalo. By Saturday afternoon things were quite normal about the big power plants, and all but one of the local tenants of the Power Company were in the enjoyment of a power supply. Of course, all the effects of the disaster had not been eradicated, but the temporary cable installation gave all desired service, and work went on in the plants that had been idle.

While the extent of the disaster was severely felt, it is probable that it could not have happened at a more timely moment. It was approaching 11 P. M. on Thursday, January 29, that the power service to Buffalo and other places was shut off, and at this hour the necessity of light and power was small; and on Friday before darkness fell, Buffalo was in receipt of power for lighting, etc. The Niagara power plants are protected by lightning arresters, but this January bolt was unstopped by the apparatus, man had designed to make it prisoner. The electrical storm broke over Niagara Falls at noon Thursday, and at Echota, a suburb of the city, the lightning struck a house. During the evening there were many lightning flashes that were very sharp, while the thunder was very heavy.

The damage to the cables alone was estimated at $25,000, but this amount does not cover the loss that was experienced.

It is now a theory of some of the electrical engineers connected with the Niagara power development that the lightning came in over what is known as the Echota line. This line is an overhead construction and runs along the poles under the transmission line, branching off to go into the suburb of Echota. Its purpose is to feed the lights in the village of Echota and to supply power for the disposal works on the lands of the Niagara Falls Power Company. Despite the fact that it was midwinter, the lightning that night was very sharp, and the idea is entertained that after coming in over the line referred to, it started a fire in the basement of the transformer station, where probably it burned some few minutes, finally causing a short circuit, which opened the circuit breakers at the south end of the power house No. 1. The short circuit, it is supposed, set fire to the cable insulation, the fire spreading to other cables located in the vicinity. After the insulation of these had burned, there was a general short circuit, which necessitated using the emergency switch to open the fields of the generators. It is thus believed that the fire originated in the basement of the transformer station, and owing to the draft or air currents the flames quickly spread into and through the bridge over the inlet cable toward the generating station.

The rapidity with which the necessary repairs were made speaks well for the efficiency of the staff of the power company. A less admirably equipped plant might have been crippled for days.

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A NOVEL AERIAL TOY YACHT.

The utilization of the wind in propelling wheeled vehicles equipped with suitable sails, on level roads or hard sand beaches, is well known. In the illustrations herewith we have the same application of wind force in an ingenious and simpler way, which will prove very attractive to young people as well as older yachtsmen, in that it provides a source of amusement of a scientific character.

The principal points of novelty are that the yacht, after traversing the length of wire, automatically comes about and sails in the opposite direction, which is repeated and may be kept up indefinitely as long as the breeze blows.

The yacht body is suspended from a wire frame shaped like an inverted triangle, at the two upper corners of which are two grooved housed wheels which travel on the track wire. The upper cross wire of this frame loops around the mast and steadies it in a vertical position. The frame terminates at the bottom in a swivel plate, through the center of which the metal mast tube projects, the lower end being swaged to permit the yacht body to freely rotate on it.

Passing through an angle plate riveted to the deck and attached to the swivel plate by a projecting pin, is a push rod surrounded by a coiled spring. The pressure of this spring between the angle plate on the deck and the shoulder of the rod holds the yacht to its course until it has reached the end of the track wire.

By means of a nut on the outer end of this rod the angle or position of the yacht body may be varied relatively with line of the wire, thereby adjusting the yacht for heavy or light winds, or according to their direction.

The yacht is made to go about by two long steel feelers, one end of which is attached to the outer end of the bowsprit. These are of piano wire heavily plated to prevent rusting. The free ends of these feelers are formed into hooks which are snapped onto the track wire. One feeler is pushed ahead of the yacht and the other trails aft on the wire.

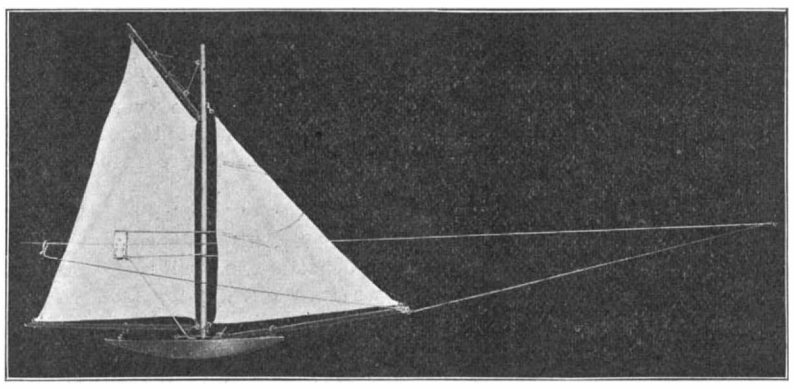
The operation of these feelers is shown in the lower illustration. The feeler which was ahead of the yacht has reached the buffer spring clamped on the wire at the end of the run. The momentum of the yacht body in striking this spring through the feeler causes the bowsprit to turn around, thus turning the yacht onto the other tack, and causing it to run to the opposite end of the course. In the illustration showing the yacht turning, the full form of the supporting frame will be observed, as it passes between the sails.

In the upper illustration, the wire feeler which traveled ahead of the yacht body before turning is now seen to follow or trail after it.

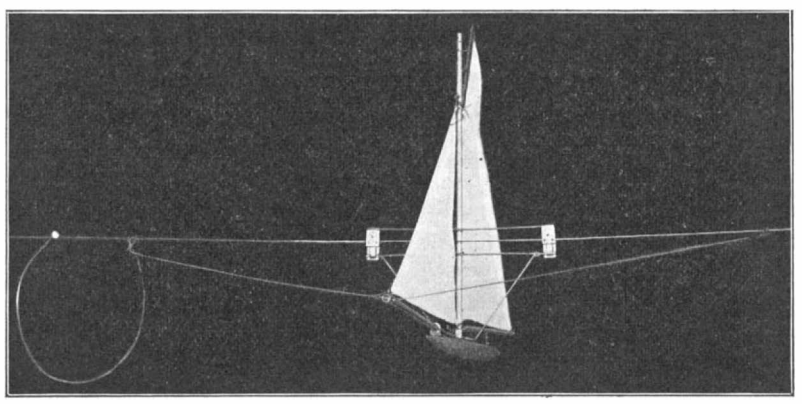
The yacht sails best on a beam wind, and by the adjustments previously spoken of can be accommodated to meet almost any wind, strong or weak.

Mr. George Breed, a mechanical engineer of Philadelphia, Pa., is the inventor. Being unable to find a suitable name for this novel flying yacht, he has offered a prize for the best name that is sent in. Particulars of the competition will be found in our advertising pages.

The most interesting sport to be had with this boat is in racing two of the yachts. For this purpose two wires are stretched parallel in a favorable place, and the contestants "toss up" for choice of position, which is the windward wire. The race is arranged to be to the end of the course and return, either once or as many times as may be agreed upon. Another method is to see which yacht will make the most trips in a given time. Each contestant holds his yacht until the word is given, then simply lets go without in any way helping the yacht to start off.



A NOVEL AERIAL YACHT.



AERIAL YACHT COMING ABOUT.

It is found that the race is not always won by the yacht on the windward wire. Much depends on the seamanship of the contestants and the ability to adjust the yachts to the varying wind. The successful racer is the one who has carefully studied the behavior of his yacht in all conditions of wind.

It is usual to have a stretch of fifty feet of wire between two posts on buildings for a sailing course, but it can be longer if more wire is provided.

THE KREBS AUTOMATIC CARBURETER FOR GASOLINE ENGINES.

Commandant Krebs has quite recently invented a carbureter for gasoline engines, which has some new and extremely valuable features. One of the great disadvantages of all carbureters used hitherto was that there appeared to be no satisfactory method of securing a uniform composition of the explosive mixture of gas and air at all speeds. The regulation of the composition of this mixture either had to be effected entirely by hand, or else it was accomplished by more or less automatic devices that were far from satisfactory. The new carbureter, however, performs this function perfectly, since it is based on the following new principle: When the motor is running at its minimum speed, the air is drawn in through an aperture of fixed dimensions, while another series of apertures of variable size is closed. As the speed is increased, and, consequently, as the flow of gasoline tends to become greater, more air is required, and this additional supply is admitted through the variable apertures, which now open more and more in proportion to the quantity of fluid that is used. The special features of the new device are two:

1st. The shape of the apertures for the additional air supply, which has been determined by calculations based on the results of a series of experiments.

2nd. The principle by which the variable apertures open in proportion to the flow of gasoline.

Regarding the first point, without entering into details, it may be stated that the form of aperture chosen is Y-shaped; it can be seen in Fig. 1, where these variale apertures are denoted by *M*. For low speeds, the top of the Y only is open, while for higher speeds the lower part also is gradually uncovered.

The second point will be best explained after reference to our illustrations. The gasoline enters the carbureter through the pipe *Z* (Figs. 1 and 2). It passes through a filter *I*, which can be detached by unscrewing the nut *N*, as shown in Fig. 2, into the float-feed chamber *B*, the float of which maintains a constant level in the spraying nozzle *D*. So far there is nothing new. When the engine is first started, it draws in a charge of air through the invariable aperture *A*, and this causes to issue from the nozzle *D* a spray of gasoline, the volume of which corresponds to the depression obtained by a speed of 200 revolutions per minute.

For speeds greater than this, the requisite quantity of additional air enters by the apertures *M*, and mixes with the gas. The proper adjustment of the apertures *M* is controlled entirely by the depression produced in the carbureter by the suction of the motor piston. In order to effect this, the carbureter has two hollow, cylindrical, sliding pistons, which serve to close or open certain ports in front of which they reciprocate. The first of these *G* (Fig. 1), or *F* (Fig. 2), is connected by means of rod *H* with the governor, by which it is operated in the ordinary way characteristic of the Panhard motors. The first piston is, in fact, simply a throttle valve controlled by the ball governor, and at will, also, by the operator. The second piston, which serves to uncover the right proportion of the variable apertures, is dependent solely on the depression in the suction pipe. In general, the motion of the second piston closely follows that of the first, since the first, by feeding more or less gas to the motor, regulates its speed, and therefore its suction, the strength of which determines the depression in the carbureter.

The second piston *K*, hollow like the first, moves vertically. Its rod bears at the top a rubber diaphragm *Q* (Fig. 3), fastened around its outer edge to the case *O*, which it works. The chamber formed in the case *O*, above the diaphragm *Q*, has only one opening to the air—a small central hole 2 mm. (0.078 inch) in diameter, so that when the disk *Q* is drawn down by the suction of the motor and recedes from the top of the box *P*, the air enters comparatively slowly into the chamber *PQ*, which readily expands by the distending of the rubber diaphragm. Similarly, when the disk rises under normal pressure, and the action of the spring *R*, the motion takes place gradually, as the air in *P Q* escapes through the hole in the center of the lid. The large dimensions of the disk are essential in order to render the piston *K* sensitive to small changes in the depression. The small hole in the lid insures an even and gradual action of the valve. Thus the cylinder *K*, moving over the Y-shaped, variable apertures, admits a regulated supply of air in accordance with the degree of vacuum produced by the piston of the motor; and the constant proportion of the constituents of the fuel gas is attained with a perfection never reached before. The result is that a perfect mixture is obtained at all times, and thus the maximum power at a given speed is always to be had from the motor. The obtaining of the 15 parts of air to 1 of gas (by weight) that go to make up a perfect mixture, is no more left to chance or hazard, but is always mathematically and precisely assured.

The new carbureter is fitted to all 1903 Panhard and Levassor automobiles, and was one of the features of the recent Paris and New York automobile shows.—Specially prepared for the Scientific American from an illustrated description in La Locomotion.

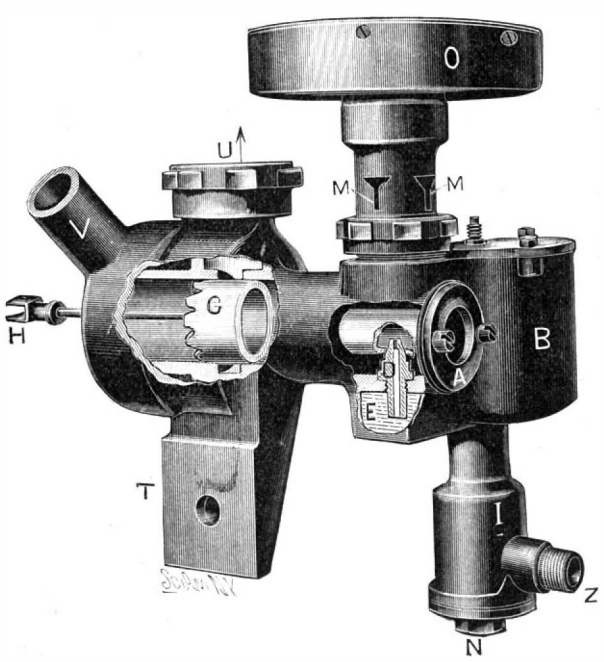


Fig. 1.—GENERAL VIEW OF THE KREBS AUTOMATIC CARBURETER.

A, main air passage; *B*, float-feed chamber; *D*, atomizing nozzle; *E*, gasoline; *G*, throttle valve; *H*, throttle valve stem connected to governor and actuated by movement of governor balls; *I*, filter; *M M*, auxiliary air openings; *N*, cap for removing filter; *O*, box containing auxiliary air valve diaphragm; *T*, lug for attaching carbureter; *U*, connection to suction pipe of motor; *V*, pipe for carrying off water from water jacket; *Z*, gasoline inlet pipe

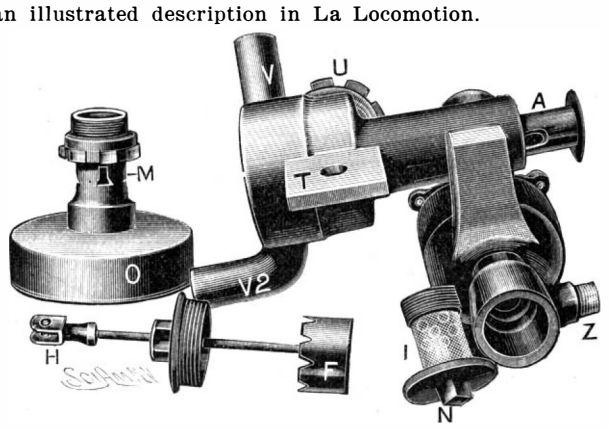


Fig. 2.—PRINCIPAL PARTS OF THE CARBURETER.

O, box containing rubber diaphragm that operates auxiliary air valve; *M*, auxiliary air openings; *F*, throttle valve; *I*, filter; *A*, main air tube withdrawn to show its shape.

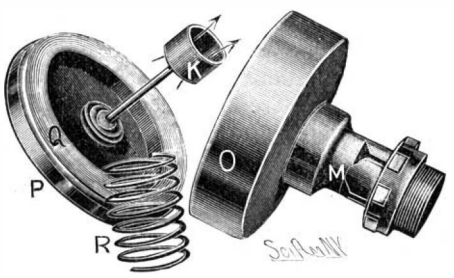


Fig. 3.—DETAILS OF THE AUXILIARY AIR VALVE AND ITS DIAPHRAGM.

P, metal cover of box *O*; *Q*, movable disk fastened to *P* by rubber ring; *K*, air valve that closes openings *M M*; *R*, spring that presses *Q* against *P* when suction of motor ceases, and that causes *K* to close progressively openings *M M*.

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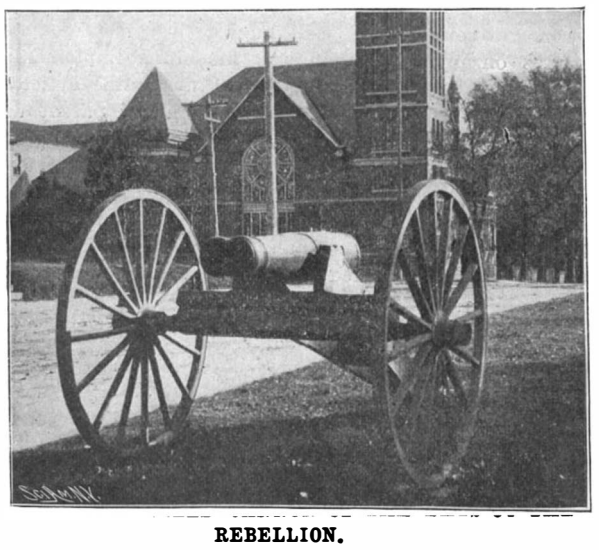
AN OLD DOUBLE-BARRELED CANNON.

In one of the city squares of Athens, Ga., stands an interesting relic of the civil war—what is probably the only double-barreled cannon ever made. It was designed by a resident of Athens for use in the Confederate service, the idea being to discharge a projectile from each barrel simultaneously, the projectiles to be connected by a chain. No chain was found to be sufficiently strong, however, to withstand the strain, and the weapon was never tested in actual warfare. The cannon is made of cast iron, and was molded at one of the local foundries. It is of 3-inch caliber, having a diameter across the muzzles of 8 inches, and across the barrels of 13 inches, while it is 55 inches in length. It is provided with what is familiarly known as a "touchhole" in the breech, connecting with both barrels, so that it could be discharged by igniting a fuse if desired. The idea of the inventor was to connect the balls by a chain several feet in length, the ends of the chain being fastened into each by staples. Chain-shot was often used in naval battles to carry away the rigging of an enemy. It was discharged once after being built, but unfortunately one barrel for some reason did not "go off." The force of the explosion of the other barrel tore the chain from the ball which remained, and gave a curved motion to the projectile. As a result of this accident, it was considered too dangerous to adopt for use, and was stored away, finally being discovered only a few years ago in a shed. It was then mounted upon its present carriage, and placed in the park for an ornament.



A REBELLION.

THE SANDSTONE QUARRIES OF OHIO.

BY W. FRANK M'CLURE.

The order of the three sandstone-producing States whose annual production exceeds in value $1,000,000 has changed within the past year, according to figures recently compiled by the United States Geological Survey. Prior to this time New York held second place, with Pennsylvania third, but now Pennsylvania and New York have changed places. Ohio, the other of the three great sandstone States, is not only still in the lead, but the value of her product has shown a noticeable increase. Ohio's total production during the last year was valued at $2,576,723, exceeding that of Pennsylvania by $513,641 and that of New York by $1,245,396 and her increase over the preceding year is represented by $343,127.

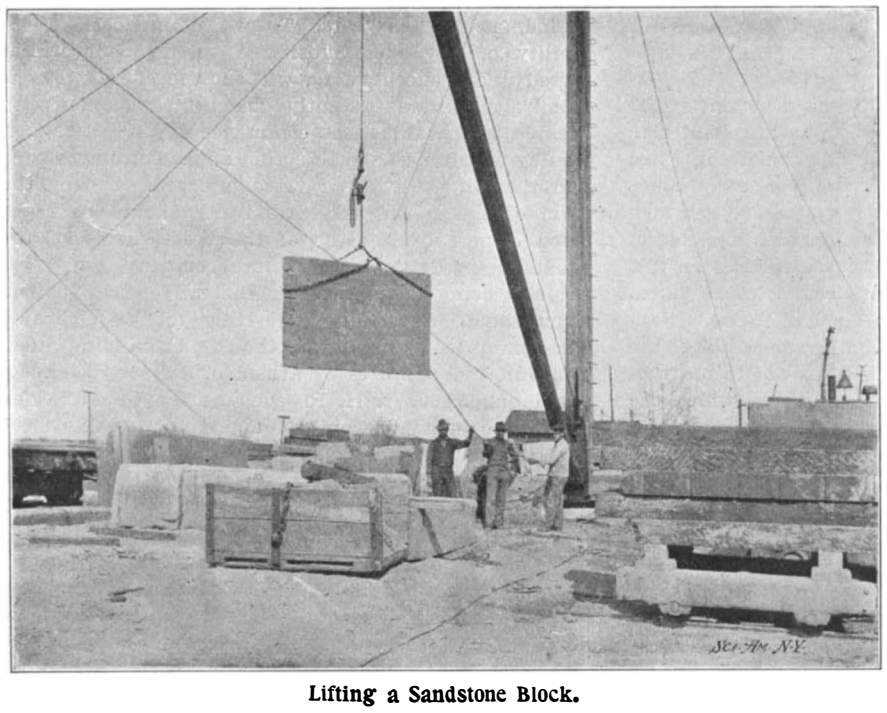
Ohio also holds an interesting place among the stone-producing territories of the world in that here are said to be located the largest sandstone quarries extant and from these quarries comes the bulk of all the whetstones and grindstones of the country. The value of her grindstone and whetstone product last year was $577,543, It is this class of Ohio's stone product too that is more in demand than her rough stone.

Of Ohio's great quarries the one at North Amherst is typical of the sandstone mining. The accompanying photographs are illustrative of a North Amherst quarry, and the claim has been made that this one is the largest. The average height of its walls is a little less than 125 feet, but in places a depth of 175 feet is attained. The circumference of this pit exceeds a mile and a half. To one who has never seen a quarry of huge dimensions a glance down from the edge of the pit, or upward from a central point at the bottom, is a novelty, to say the least. The layers of stone are so distinct that they may be distinguished from one side of the quarry to the other. Another interesting feature is found in the different colors represented by the various strata. There are different qualities of sandstone to be found in the same pit; the kind used for whetstones or grindstones represents one stratum, while that used for building purposes represents another. Bluestone is a kind of sandstone; it is used for flagging and curbing. Sandstone, it will be recalled, is but sand more or less firmly united.

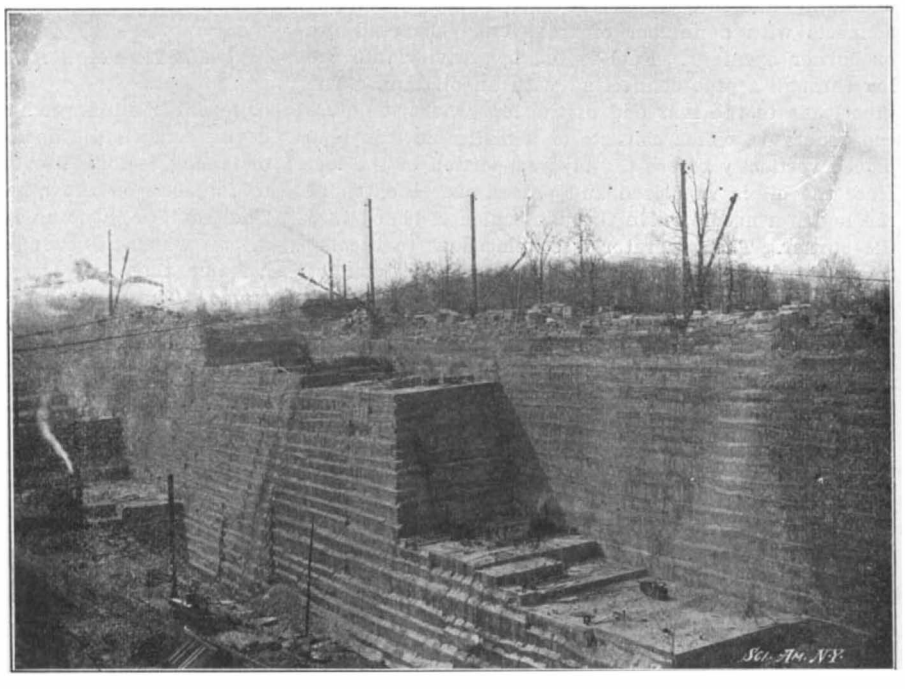
Like in the case of the coal mine many years are usually required to exhaust the supply. At North Amherst it is said to be more than thirty years since the great development of the quarries there was begun. Few rural sections witness the steady employment of as many men. A quarry of the size of the one illustrated often employs as many as 500. The operations in which these men engage are not in the main intricate, and yet, as in nearly all lines of industry, some skill is required in the different departments.

In the removal of sandstone the first operation consists in bringing to bear an even pressure at the bottom of a block of stone simultaneously with the work of piercing the upper surface in numerous places. Steam drills are used to pierce the upper surface, while the pressure at the bottom is maintained by means of wedges. The row of drill holes from the surface meets the wedge openings underneath. The second operation consists of sawing vertically from hole to hole. The saw used for this purpose is operated by steam power. When a block of the desired size is severed by means of the saws, it is hoisted by derricks.

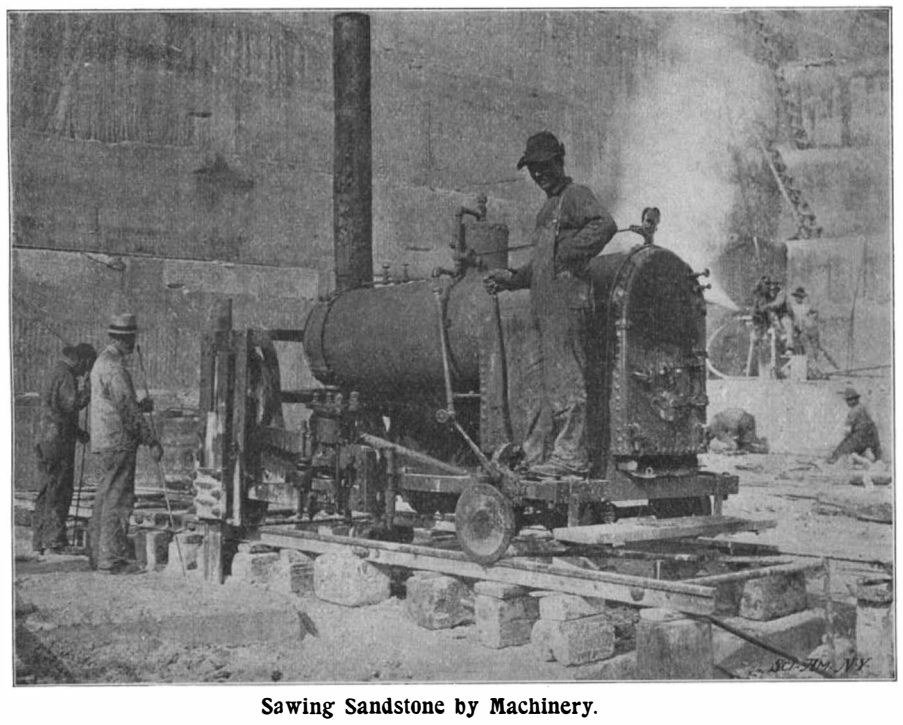
About the tops of the cliffs at the surface of the ground the further work of preparing sandstone for the market progresses. It is here that the grindstones assume shape. The stone to be used for this purpose is transformed from its square shape to a more circular form. It is next placed upon a machine which causes it to revolve rapidly while the workmen ply their crowbars in perfecting its shape. The saws used in cutting the rough stones of large dimensions into smaller ones of various sizes are simply long strips of iron which swing back and forth in gangs, thus wearing their



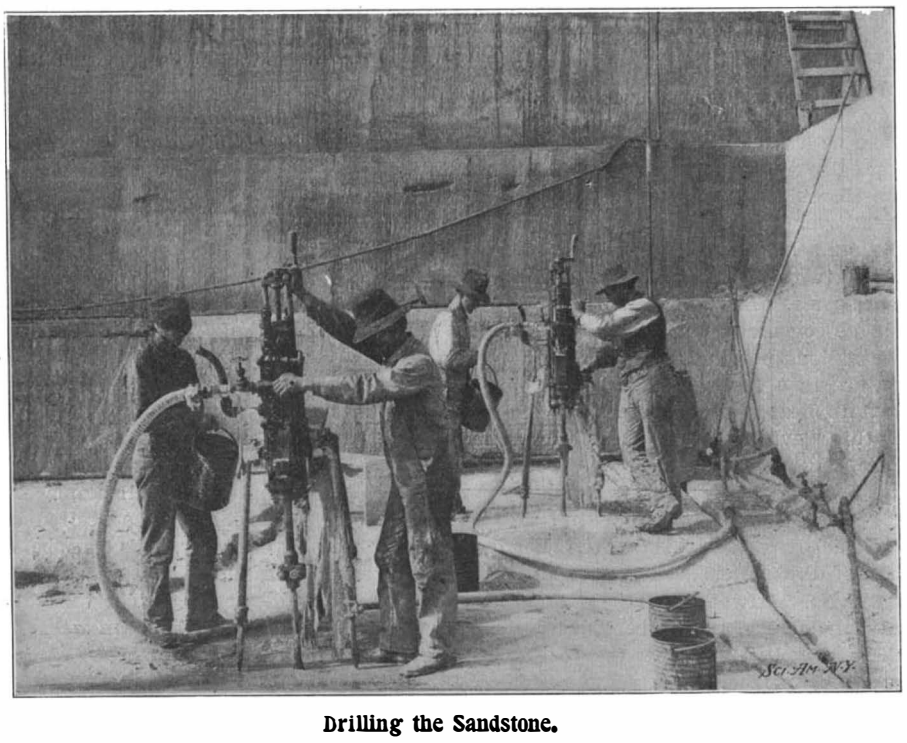
Lifting a Sandstone Block.



Sandstone Layers in an Ohio Quarry.



Sawing Sandstone by Machinery.



Drilling the Sandstone.

THE SANDSTONE QUARRIES OF OHIO.

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way through the piles of stone in the course of time. A mixture of sand and water placed about the saw blades assists them in the operation of cutting. The gangs of saws are operated by machinery.

In winter the quarrymen clear the quarry of all refuse material such as broken stone and quantities of sand. In the work of removing the small bits of stone and sand a locomotive hauling a train of flat cars will be found at many of the quarries.

With reference to the sandstone quarries of the next State in rank to Ohio, Pennsylvania's yield has been increased largely in the line of building stone. The value of this stone alone last year showed an increase over the preceding year of $1,131,988. The bluestone localities also showed an increase in value of $44,903. Notable also in connection with Pennsylvania's stone quarries has been the progress made toward the consolidation of many of the sandstone and limestone interests. Both railroads and quarrymen are interested in this move.

In New York the principal sandstone region is in Orleans County. The belt is said to be a narrow one and not much more than 25 miles in length. The stone from this section is largely used for building purposes. From these quarries also come large quantities of stone for paving. Another important stone belt is near Potsdam, St. Lawrence County. Although the production of the State for last year as a whole showed a decrease, plans are on foot in some sections for enlarging the handling facilities. Comparatively recent has been the consolidation under one head of interests which in the past have been owned by many, and this, too, will result in quarrying upon a larger scale.

A NEW OIL BURNER.

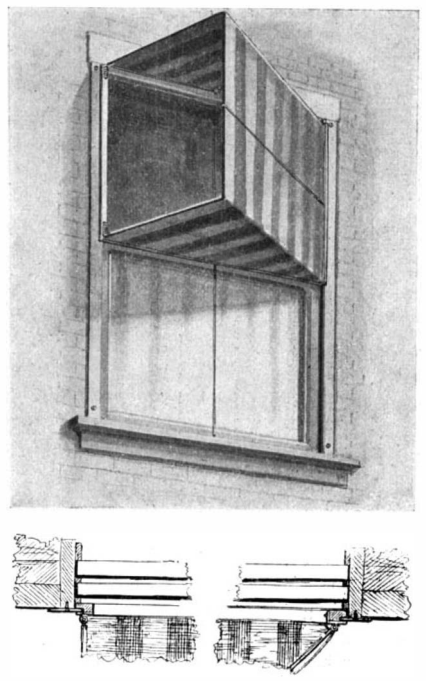
An improved oil burner has recently been invented which is especially designed for use in the firebox of the ordinary domestic cooking stove or range. An essential feature of the invention is the design which permits the burner to be readily fitted into the stove without necessitating any material changes in the construction of the latter. The accompanying engraving illustrates the burner as placed in a range. It will be observed that the furnace consists of a body or log tapered at one end and provided with a longitudinally-extending flue into which the fuel is fed. This flue connects with a number of transversely-disposed fire or burner openings. Fuel is fed by gravity into the log through a pipe connecting with an oil tank. The pipe leads to the rear end of the log, where it enters the generator, which consists of a malleable iron pipe placed vertically before the tapered portion of the log. Here the oil is vaporized and passes over the top of the log to a needle valve through which it is fed into the burner. The generator is so placed as to become thoroughly heated without coming into direct contact with the flames. In order to take up any overflow of oil that may occur when first lighting the burner, a drip-pan lined with asbestos is provided under the needle valve and also under the body proper, as shown in Fig. 1. As soon as the log has been sufficiently heated, this surplus oil is vaporized and passes up into the burner, as indicated by the arrows. In this way the disagreeable odor which forms an objectionable feature of so many oil burners is avoided. At the same time the openings in the bottom of the log serve to increase the draft. In order to further consume all the carbon and make the burner absolutely odorless a water pipe is provided for feeding water in drops into the jet at the needle valve. The water is immediately vaporized on coming into contact with the hot jet, and passing into the burner assists in the combustion. The combustion of the gas, it is claimed, is so complete that whatever deposit has been formed by the oil when first lit, is, in a short time, consumed, and the firebricks soon look as clean as a new sheet of manila paper. The water feed also reduces the noise of the burning gas considerably. The flames fill the firebox and shoot over the oven, heating the same very rapidly and keeping it at a uniform temperature. Water in the boiler is made hot in a remarkably short time. Any good fuel can be used which will be consumed at the rate of one and a half to two gallons per day. The burner is also adapted for use in a furnace, a single burner being sufficient to heat a medium-sized dwelling. The inventor of this device is Mr. Oscar Falkenwalde, of Baltimore, Md.

The Current Supplement.

"Some New Arrivals at the London Zoo" is the title of the article which opens the current Supplement, No. 1415. This article is not the only one on natural history, for Albert Hart discusses sponges, where they live and how they are obtained, and tells something of their uses. R. Lydekker has something to say on some peculiar products. Foucault's pendulum experiments can be repeated by means of a small-scale apparatus which is fully illustrated and described. Dr. T. Byard Collins gives a critical account of the airship of M. Frederick l'Hoste. Miscellaneous articles, short, but bright and entertaining, are also included in the columns of the current Supplement. Physicians will appreciate an article on the ambulance work in country districts of Germany. The Fire Walk Ceremony of Tahiti is one of the curious rites performed by savage nations which has attracted no little attention among ethnologists. Prof. S. P. Langley during a visit to the Fiji Islands observed the ceremony carefully and presents, in a very exhaustive article, a scientific explanation of the phenomena. Prof. Warren Upham, well known to paleontologists, writes on primitive man and his stone implements. Fred T. Jane continues his naval war game articles. The recent Berliner telephone transmitter patent decision is digested.

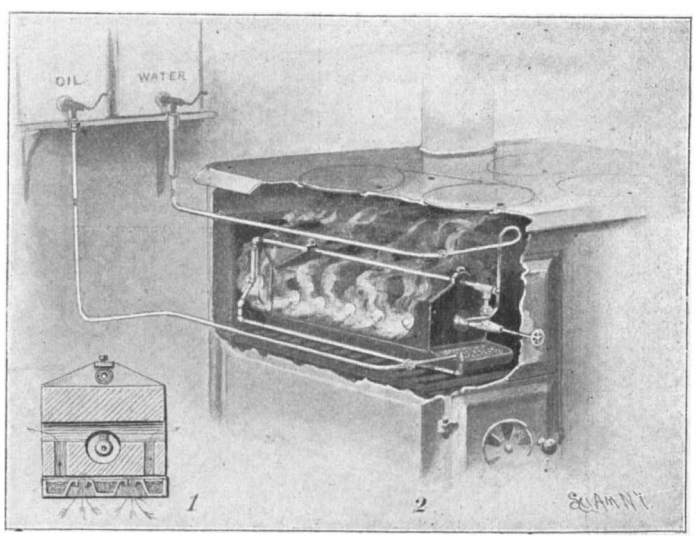
VENTILATOR.

An excellent ventilator for use in summer weather is illustrated in the accompanying drawings. This ventilator may be attached to a window casing to direct



COMBINATION AWNING AND VENTILATOR.

or force air into a room through the open window. The device comprises a hood of canvas or awning material, or it may be formed of metal or wooden slats designed to fold one on the other, similar to Venetian blinds. The front, or open end of the hood, is attached to a metal bow which has swinging connection with one side of a frame, the other edges being secured to rails on this frame. The ends of the bow are connected to spiral springs which serve to hold the hood in its open position. By drawing the cord fastened to the center of the bow the hood can be folded back so as not to obstruct the light from the window. The frame to which the hood is secured is mounted to slide in vertical guideways in the window casing. It may be drawn up to any desired position by operating the cord attached to the frame and passing over a pulley at the top of the window casing. It is designed that the opening of the ventilator shall be placed in a general direction of the wind. If it be desired to change the direction of the ventilator, this can be easily done by taking out a fastening screw of one of the guide plates of the window casing. The ventilator frame can then be removed and reversed. In warm weather this device affords an efficient ventilator, shutting out the heat of the sun, and at the same time causing a greater circulation of air in the room than would result were the open window not provided with this device. The inventor of this device is Mr. Robert E. M. Bain, Century Building, St. Louis, Mo.



IMPROVED OIL BURNER PLACED IN A RANGE.

Subsidizing of British Mercantile Vessels for Naval Purposes.

BY THE LONDON CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The report of the committee organized by the British government upon the question of armed mercantile cruisers has been published. The committee were specially appointed to investigate generally the problem of the utilization of mercantile vessels as auxiliary cruisers in time of war; what boats might be secured for this purpose from the present mercantile fleet of Great Britain sufficiently strong from a structural point of view to carry an armament of 4.7-inch guns at least; and what vessels should be prevented by subsidy from passing under a foreign flag. In this report the committee has embodied several recommendations, by which means the foregoing requirements might be fulfilled. The results of the investigations of the committee proved that the majority of the large vessels of the British mercantile marine of high speed are structurally strong enough to carry and fight 4.7-inch guns; are subdivided to the present requirements of the Admiralty; and can be fitted with the official steering gear below the water line without difficulty, and at an expense of from £2,500 to £5,000 per annum, including interest on excess of first cost, depreciation, maintenance, etc. In connection with the initial cost of vessels of 25 knots, which is the present desired speed of these vessels, and also the extent of the annual subsidy requisite to compensate private shipping companies running such vessels in times of peace, three recommendations have been advanced by the committee. The first suggestion is that the Naval Department should guarantee the representative cost of the vessel, to enable the shipping owner to raise the capital at the nominal rate of interest of 3 per cent instead of the general 5 per cent; or secondly the Admiralty should contribute a lump sum toward the first cost of the vessel, thereby reducing the shipping owner's outlay; or thirdly, the Admiralty should make an annual payment extending over a number of years.

The committee has based its calculations upon the present cost of running large mercantile vessels, but has not overlooked the fact that in the future the expense of running will possibly be greatly reduced by the employment of oil fuel, steam turbines, etc. With regard to the subsidy, they suggest that it would be necessary to guarantee the bounty for a considerable period, such as ten years. To provide against the possibility of any such subsidized vessels being transferred under another flag, without the consent of the Admiralty, as was recently done in connection with the White Star Line, the committee advance a suggestion by which means such action might be controverted and their interests in a vessel secured. During the term of the subsidy the Admiralty should be registered owners of 33-64ths of the vessel at least, the profits being left wholly to the company, and legal security being taken to show that all owners' obligations should appertain exclusively to the company. The committee estimate that the cost of building liners to fulfill the purposes of armed cruisers of 25 knots speed and 52,000 I. H. P., such as the Cunard Company have in hand, would be approximately $5,000,000 per vessel. In connection with the tenders for the two new 25-knot vessels the Cunard Company are building for the Admiralty, in accordance with the terms of the subsidy agreement issued a few weeks ago, the Naval Department have imposed very severe and unusual conditions upon the builders. The contracted speed is to be 25 knots, and if at the end of twelve months' service the boats have not averaged this speed throughout their voyages during the year, they may be returned to the builders. To be more explicit, this stipulation practically means that the boats have to undergo one year's speed trial. The majority of the shipbuilders in the country consider this an impossible condition, since after the vessel has passed out of their hands it might fail to maintain the requisite speed from causes over which they had no control. Also in view of the enormous risk a shipbuilder will incur in the construction of the vessels, which may possibly be thrown back upon his hands after a year's service, many of the builders have refrained from tendering for the construction of the ships. The government are advancing the necessary capital to build these two boats at three per cent interest, on the security of the entire Cunard fleet, including these two new vessels, and the Naval Department are paying the company $750,000 per annum for the use, when necessary, of the entire Cunard fleet.

A photographic copy of the fourth patent issued by the United States was recently secured by the authorities at Washington, who have been recently engaged in a search to recover some of the oldest papers. The whereabouts of the original of this one is not known. It was granted on January 29, 1781, and was issued to Francis Bailey, of Philadelphia, and covered a process for "performing punches." The document bears the signatures of George Washington, Thomas Jefferson, and Edward Randolph.

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Correspondence.

A Suspended Tunnel.

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of the SCIENTIFIC AMERICAN of January 24 last, in an article on "New Methods of Tunneling," you describe three methods suggested for the support or foundations of the proposed North and East River tunnels of the Pennsylvania Railroad Company. In my opinion, there are serious objections to each of these plans.

The one proposed by Mr. Jacobs, the railroad company's engineer, is, if I understand it correctly, simply a girder bridge of several spans incased in a tunnel with foundations at each span reaching down to bedrock. The inclosing of these girders inside the tunnel makes it necessary to build the tunnel of very large outside diameter, which fact makes it very difficult of construction and *very costly.*

Mr. Sooysmith's plan of freezing the silt is, I believe, too much of an experimental nature, as yet, for tunneling to warrant its adoption in an undertaking of this magnitude. The adoption of Mr. Sooysmith's plan of driving piles throughout the whole length of the tunnel would certainly disturb the silt through which the tunnel would have to be pushed, to such an extent that in all probability it would be of the consistency of builder's mortar, and consequently very difficult to tunnel through.

As to Mr. Reno's plan of pushing the tunnel in the usual way by means of a shield, and the use of compressed air, I believe it to be the correct way; but as to his method of providing a foundation for the tunnel, I cannot approve, for the reason that the solidity of the concrete foundation would depend entirely upon the solidity of the silt or other material upon which the concrete rested. Consequently, it seems to me it would be quite unsafe to rely upon a foundation of this nature.

With your permission, Mr. Editor, I will suggest a plan for supporting these tunnels, entirely different from either of the above named. I would suggest that the tunnels be built in the usual way, as Mr. Reno suggests, by the use of a shield and compressed air, and that at each end of the tunnels, as close to the water's edge as possible, a substantial foundation be built upon the bedrock, and of sufficient height to reach about half way up the tunnels at each side. These foundations are for the purpose of supporting wire cables, which would be run through the inside of the tunnels, one at each side, and securely fastened thereto and anchored at each end, as in those of any large suspension bridge. From these two cables the car tracks would be suspended. This method of suspending the tunnels on wire cables would effect a very large saving, as the diameter of the tunnel could be much less than those containing bridge girders. It could also be built in much less time than either of the three plans above mentioned, as the tunnel and the cable foundations could be proceeded with simultaneously.

J. S. PARMENTER.

Woodstock, Ontario, Canada, February 2, 1903.

The Cause of Thunder Again.

To the Editor of the SCIENTIFIC AMERICAN:

I note with interest the theory of the cause of thunder advanced by Robert V. R. Reynolds on page 41 of your issue of January 17.

I fully agree with Mr. Reynolds as to the fallacy of the vacuum theory. Perhaps most fairly educated men will recall how unsatisfactory was the explanation of the learned (?) professor who first imparted to them the information that the noise of thunder is "due to the air rushing in to fill the vacuum caused by lightning passing through it;" when to their boyish minds every peal of thunder within their hearing had already firmly established the conviction that in each case "somethin's busted," "exploded," "blown up."

In later years, when called to mind at all, the conviction is still more firm with me that a deafening peal of thunder is the result of a violent explosion of gases of high efficiency, rather than the rushing together of walls of air at about normal atmospheric pressure.

The vacuum theory seems unreasonable and unsatisfactory in at least two particulars:

First: So far as I am aware, it has never yet been satisfactorily demonstrated that the mere discharge, or passage, by whatever technical term designated, of an electrical current, however powerful, through the atmosphere, produces any perceptible disturbance in that atmosphere or any portion of it, let alone displacing oceans of air, leaving a completely walled-in vacuum of thousands or millions of cubic feet.

Second: Granting the creation of the vacuum, the theory that a volume of air regaining its equilibrium under fifteen pounds pressure can produce the deafening roar of a peal of thunder seems absurd and preposterous.

If this "air rushing in to fill a vacuum" theory is still being advanced by the salaried professors of science throughout the country, as Mr. Reynolds' article seems to indicate, then certainly some suggestions from laymen may not be amiss. Following this example, and also "at the risk of advancing a theory which may have been already presented by meteorologists," I will suggest a theory somewhat at variance with that of Mr. Reynolds.

Some years since, a friend—Prof. H. A. Lewis, superintendent of our schools—and myself, whiled away a leisure afternoon in experimenting with some new apparatus just received for the high school laboratory. Among other experiments we decomposed a small quantity of water by electrolysis, using for the purpose a small cell battery. The apparatus is very inexpensive, and the experiment may be tried by any novice, with a little instruction from some high school student familiar with the experiment.

Two glass tubes, closed at one end, were filled with water and then inverted in a dish of water, in the usual manner, for the reception of the hydrogen and oxygen gases respectively.

These two apparently harmless gases, as is generally understood, become highly explosive when brought in contact with each other in proper proportions and a flame applied. Accordingly, when the hydrogen tube was two-thirds filled, the battery was disconnected, and the balance of the hydrogen tube was carefully filled with oxygen from the other tube. The wires were then properly arranged to pass a spark through the gases, the battery again connected, and the expected happened—a violent miniature explosion, shattering the glass tube into fragments, while the gases, following a natural law, as the result of the explosion fell to the table in the form of the water from which they had been decomposed.

Briefly, a slight electrical current, with the aid of a little sulphuric acid, decomposes a dish of ordinary water into two gases, hydrogen and oxygen. These two gases are collected, and brought together in proper proportions. A spark from the same current that generated the gases converts them into the same water from which they were generated, or decomposed; the water falls into the dish from which it started. Here, then, seemed to us the logical solution of the cause of thunder.

Now, as to the application: The heavy, moisture-laden clouds represent a huge dish of water. The electricity of the atmosphere furnishes a current equal to that of perhaps millions or billions of our experimental cell battery. This current, with resources of a magnitude beyond comprehension, rapidly decomposes the water of the heavily saturated atmosphere or clouds, into the two gases in vast volumes.

These gases rise in strata possibly miles and miles in length—limited only by the extent of the field, or water cloud, upon which the current is operating. In rising they rapidly commingle or permeate each other, until there is an explosive mixture of tremendous volume. When the conditions are right—when the proportions are correct to form a high explosive—a flash from the same current that has been generating the elements of this mixture explodes the charge, and we have thunder as the result of a violent explosion—either as a short sharp crash due to the explosion of a limited volume of the gas directly overhead or in the immediate vicinity of the hearer or the long, reverberating roll, due to the difference in time required for the sound waves to travel to the ear from the nearest to the farthest point of an explosion of a long stratum of the gas, returning possibly for miles along the crest of some heavy cloud.

Is not this a more rational, logical theory as to the cause of thunder than that it is caused by a volume of air at fifteen pounds pressure rushing in to fill a vacuum that has never been demonstrated to exist?

If this theory or solution of the cause of thunder is not perfectly logical in every sense, will the SCIENTIFIC AMERICAN kindly explain, editorially, why it is not?

One further point: The wise professor who explained the vacuum theory of thunder, also explained that the heavy precipitation of rain immediately following a heavy peal of thunder, was due to the concussion—the vibration from the concussion jarring the moisture together into drops and shaking the drops down, as a boy shakes apples from a tree. While it is true that there may be some basis for the theory that detonation, such as that of heavy cannonading, etc., will precipitate moisture, it is still open to question; and how much more simple and logical is the explanation that the heavy precipitation immediately following a peal of thunder, amounting in some instances to a cloudburst, or the dropping of almost a solid body of water, is only a natural consequence.

The same explosion which causes the sound of thunder also converts a large volume of gases into pure water—the water simply falls from force of gravity in greater or less quantities in proportion to the volume of gases exploded and converted into water.

E. L. BATES.

Pentwater, Mich., January 21, 1903.

[The commonly accepted mode of accounting for thunder may be stated in a few words as follows: "The lightning heats the air in its path, causing sudden expansion and compression all round, followed by a sudden rush of air into the partial vacuum thus produced." (Quoted from Silvanus Thompson's "Elementary Lessons in Electricity and Magnetism.")

We presume that this is the theory with which Mr. Reynolds and Mr. Bates are dissatisfied.

We would venture to suggest that they have attached too little importance to the first part of the statement of this theory as given in Prof. Thompson's book.

When hydrogen and oxygen unite to form water vapor it is the heat produced, and it only, which causes the explosion, for at the same temperature the hydrogen and oxygen together occupy more space than the water vapor formed (supposing it to remain vapor and not to condense to water).

$$H_2 + O = H_2O.$$

2 vols. + 1 vol. = 2 vols.

So whether there is any electrolysis of the water or not it is equally true that the noise of thunder is produced by the sudden heating of the substances in the path of the lightning as stated above. The expansion causes a compression of the surrounding air which rushes in to fill the partial vacuum. This in turn forms a second partial vacuum and thus the alternate condensation and rarefaction of the air produces sound waves. Judging by the pitch of the sound produced these waves are very long, which shows that the disturbance also must have a great length. To introduce any hypothesis of an electrolytic dissociation only complicates matters and moreover brings in an element of doubt, where none is needed, and by which nothing is gained.

It is very doubtful if the presence of any ordinary quantity of moisture in the air appreciably affects the nature of the noise of thunder. From the conditions of the case (i. e., the extremely high temperature and the suddenness of the lightning), it seems extremely improbable. It is no small matter for a large volume of air to be heated to several thousands of degrees centigrade in a vanishingly small part of a second, and the presence or absence of a small percentage of water is not likely to tell in view of the magnitude of the effect attributable to the heating of the air alone.—ED.]

The Langley Aerodrome's Accidental Flight.

Prof. Langley's aerodrome took a rather unexpected flight on January 31. The machine was moored to a houseboat in the Potomac. During a heavy gale it rose from its usual recumbent position and tried to soar. It was fastened to the houseboat, but is said to have snapped the mooring lines of the boat and to have taken that along with it. According to the watermen along the river, the houseboat was dragged along for a while, while the machine maneuvered strangely in the air. After a number of peculiar twists and turns the aerodrome and the boat ran into a steamer. Twenty feet of the steamer's guard rail were torn away. The aerodrome was caught in a flagpole.

On October 21 Prof. Cunningham delivered the Huxley lecture discussing the subject of right-handedness and left-brainedness. So far as evidence goes it seems probable that right-handedness was a characteristic of man at a very early period. It is an inherited quality in the same sense that the potential quality of articulate speech in man and of song in birds are inherited possessions. Investigation shows that right-handedness is due to a transmitted functional pre-eminence of the left brain, and this factor prevents an oscillation of the condition from one side to the other in those curious cases in which the right and left sides of the body are reversed and the thoracic and abdominal viscera transposed. The greater part, if not the whole, of the motor incitations which lead to articulate speech go out from the speech center in the left cerebral hemisphere. Left-handed people speak from the right brain.

Mr. J. N. Maskelyne, of London, has been experimenting for some time past with a wireless telegraphic apparatus of his own design, which is being installed upon a number of cable vessels. Maskelyne has attracted no little attention by his attempt at tapping Marconi's messages. He has installed a station at Porthcurnow in Cornwall, 18 miles from Marconi's Poldhu station, and has been able to receive some of the messages that Marconi has dispatched to or from Poldhu. Maskelyne even received and deciphered the messages transmitted by Marconi from Nova Scotia. Marconi claims that Maskelyne received only imperfectly attuned messages.

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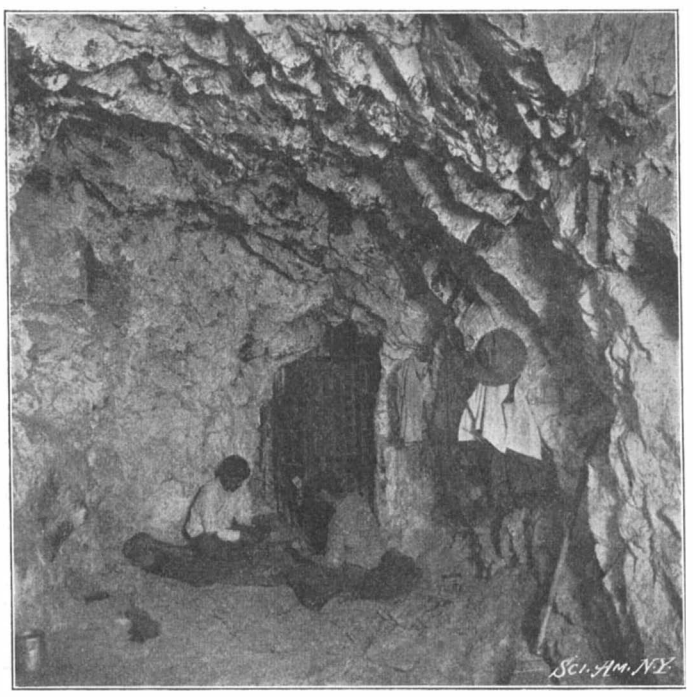
THE INVENTIONS OF DR. WILLIAM CHURCH.

(*Continued from first page.*)

effected by means of a cam (not shown), which, in the further advance of the wheel *I*, struck the friction roller at the upper end of the lever *O*, and caused the opposite end of that lever to draw forward the matrix bar by its connecting piece *P*.

The next operation was that of discharging the types from the mold, which was done by a cam (not shown) on the periphery of the wheel *I* coming into contact with the friction roller of a lever, connected by its shaft with the lever *R*, so that both moved together. By the movement of the first-mentioned lever, the lever *R* forced down the punch-bar *S*, connected with it by the link *m*, from the underside of which bar clearing punches protruded. By the descent of the punches into the groove of the mold-bar *B*, the types were projected downward and descended into a guide which was twisted one-quarter around, in order to bring the bodies of the type into proper position, so that they could arrange themselves side by side in the same manner as when placed in a line by a compositor. The last-mentioned cam having passed the friction roller of the lever *Q*, the weight V^1 descended and lifted the lever *R*, which raised the punches out of the molds to their former position. Another cam, on one of the spokes of the wheel *I*, now struck the roller at the lower end of the lever *O*, and pushed it back, thereby causing the connecting piece *P* to drive back the matrix bar *C* to its former position. The locking of the matrix-bar was now to be effected by still another cam (not shown) which came into contact with the under side of the friction roller of the lever *M*, which pushed it back again, and drew the previously mentioned wedges up into the slots of the loops. The next motion of the mechanism was the sliding of the mold bar back into its former position. This was done by the friction roller of the lever *L* (as the wheel *I* passed onward), descending from an enlarged part of the periphery of the wheel *I* to the reduced part of the periphery. The lever *L* connected with its short lever was pulled down by the weight and shifted the mold-bar back to its initial position. The wheel *I* having performed an entire revolution, brought the cam *c* again under the friction roller of the lever *J*, thereby raising the plunger and permitting another operation of the casting to begin. After the types descended in the twisted guides, they were pushed backward into the ranges of the box *U*, by means of the guide cams *V V*, fixed upon the shaft *H* of the hand wheel *G*. The friction roller at the end of the lever *W* acted between these cams. By the revolution of the shaft and the cam, the lever *W* was caused to oscillate so that the bar *X* connected with the punch projector bar was reciprocated. Thus, at every revolution the punches were forced through the twisted guides to drive the types one after the other in their exact position into the ranges of the box *U*.

Having disposed and arranged the several types into narrow boxes or slips, each slip containing a great number of types of the same letters, was placed in the upper part of the composing machine in boxes *A A*. From these boxes the types were removed by a mechanism operated through the movement of a keyboard, very much as in the modern typewriter or linotype machine. But since Dr. Church knew knew nothing of typewriters, he quaintly tells us that this composing machine of his is operated "in a manner somewhat similar to the jacks and keys of a harpsichord." The heads of the vertical key-levers or "jacks" slide in slits formed in a plate. The number of jacks is equal to the number of boxes of type. When one of the keys was depressed by the finger, the end of the corresponding jack was caused to advance and push forward the undermost type of the corresponding file. By the descent of the key the bar *c* was forced down, thereby depressing the arms *d*, and raising a lever, by which a clock train, situated back of the machine and therefore not shown, was set in operation. This clock train gave oscillating motion to two rods, *Q Q*, rising up to a cross lever which was fixed upon a shaft *s*. At the front end of the shaft the arm *t* was fixed, forming nearly a right angle with the cross lever. Our illustration shows the action of this arm *t* upon the shaft *v*. To the right of the arm *t* is fixed a corresponding arm *u*. Both arms were operated together by cross rods *w*. The clock train, on the depression of a key, caused the ends of the cross lever to vibrate, which caused the arms *t* and *u* to swing from side to side. To the lower ends of these arms small rods *x x* were attached, which at every vibration of the arms carried attached collectors *y y* toward the middle of the race *z* and back again.

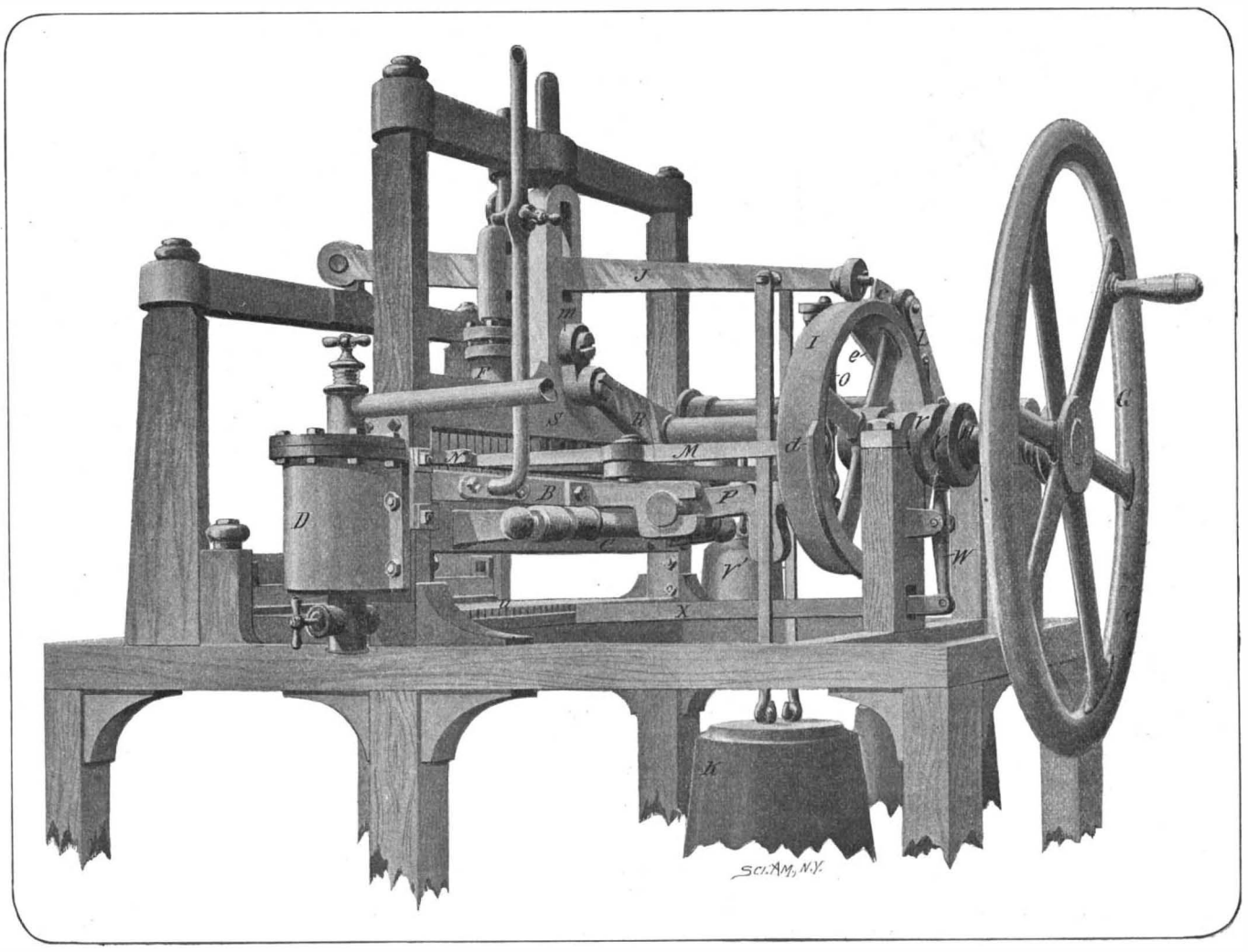


INTERIOR OF AN ARIZONA CAVE-JAIL.

It is now necessary to refer to the situation of the type which has been pushed forward by a key lever into the race *z*. The collectors in advancing brought the type into the center under the beak of the lever c^1, at which instant the clock train caused the back part of the lever c^1 to be lifted and the type to be placed under its beak and to be pushed down the aperture d^1 into the curved channel e^1 which "acts as a composing stick," Dr. Church tells us, In this mechanical composing-stick the types accumulated and were progressively collected into words and sentences, and these were then taken and adjusted into lines by hand or collected into pages by means of a box which was placed at the side of the machine at the end of the "composing stick" e^1.

The third portion of Mr. Church's invention is a press for printing and delivering the sheets in a pile. The inking rollers were mounted in a frame, and were supplied from a distributing table with a lateral movement. At each movement of the frame ink was transferred by the rearmost inking roller from an endless band connected with a trough, and having a ratchet movement consequent on that of the roller frame. The roller frame was driven to and fro over the form by means of a belt connected with the shaft of a crank wheel. Having proceeded nearly over the form the roller frame was locked by means of a slider with the frisket frame and carried it under the platen. The impression was given by the rising of the type by a knee lever or descent of the platen. The printed sheet was then removed by nippers on endless bands passing over and under the platen and discharged. The register points were attached to the frisket "in a manner similar to that by which they are attached to the tympan of an ordinary press." The frisket was furnished with wedges which dropped into corresponding recesses in the platen or in the table and thus insured perfect register.

In Hansard's "Typographia," published in 1825, some interesting criticisms are to be found on Church's method of casting and composing type. After disclosing the operation of Church's machines, the writer remarks: "Well—suppose all this done, the performer also perfect in his knowledge of the keys and beginning to play his lesson—how long would he proceed with his tune without meeting with some unlucky note in his ballad, without having to call for some performers to play in concert? One to help the instrument to space out its lines; set its heads (italics I suppose would be provided for by another row of keys and pipes to answer those of the swell organ); then another to set smaller type for notes; a word or two of Greek or Hebrew, or, perhaps, side notes to the word; to space out heads, gage and tie up the pages; to emboss, correct, etc. To effect this saving of three parts in four of a compositor's labor, would take one key player, two helpers, one reader, one engineer, and one artist to keep such a machine in repair; and then if a simple key or trigger out of the 153 wanted for the boxes or a pair of cases should get out of tune, the whole foundry and composing machinery must all be brought to a dead stop." Hansard also refers to the "invention of one M. Henri Didot of Paris, made patent in this country by Louis John Pouchée, for casting type at the rate of 24,000 per hour." Hansard states that there is a complete identity in the machinery of M. Didot and Dr. Church; "and this, according to the law of patents, will put the exclusive right of the latter to any part of his patents to some jeopardy if ever contested. But an English expired patent anticipated them all; at least that this idea of casting type in multiplex molds is not entirely novel will be seen by referring to an expired patent of William Nicholson, granted to him in 1790." In this Hansard is wrong. The Scientific American has taken the trouble to look up this patent of Mr. Nicholson of 1790, and does not find that it involves the setting of type by machinery as in the Church patent. We are, therefore, probably correct in assuming that Dr. Church's invention is about the first patented type-casting and type-composing machine.



DR. WILLIAM CHURCH'S TYPE-CASTING MACHINE OF 1822.

A CAVE USED AS A JAIL.

One of the strongest jails in the country is located in Graham County, Arizona, in the town of Clifton. This com-

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munity is situated in a valley on one side of which rises a hill composed principally of quartz rock. When the county authorities desired to have a place for confining prisoners, it was decided to make an excavation in the hillside, which was done by blowing out the rock with explosives. The opening was made merely large enough for one man to pass through without difficulty, while the interior was excavated like a coal mine, and divided by natural partitions into four cells. No effort was made to finish the interior of the cells, the roof and sides being left in the jagged condition caused by the blasting. To admit air and light, several holes were made in the hillside, also by means of explosives, and the openings secured by bars of steel about an inch in diameter, driven into holes in the rock and cemented.

The entrance was fastened by means of a door also composed of steel bars; but as a means of further protection and to provide accommodation for the sheriff and his officers, an artificial wing or vestibule was constructed of rough masonry, the stone which had been blasted out of the excavation being used for this purpose. The vestibule is divided into two sections, so that, in order to reach the jail proper, one must go through three barred gates. While the cells are but four in number, each is large enough to hold several inmates, and this novel jail can accommodate a score of persons at one time if desired. Although the walls, sides, and roof are composed of rock, the interior is dry, and the inmates suffer far less discomfort than many of those who are placed in artificial structures. The thinnest part of the wall of this jail is over six feet in thickness, so the jail, besides being fireproof, is certainly secure.

In order to prevent the substitution of inferior goods in an original bottle, an inventor who has recently secured a patent on his scheme, proposes to embed a dime or other coin in the body of the bottle, which, he claims, will be sufficient inducement to secure the destruction of the vessel when it has been emptied.

TRANSPORTING LUMBER ACROSS DEEP GORGES.

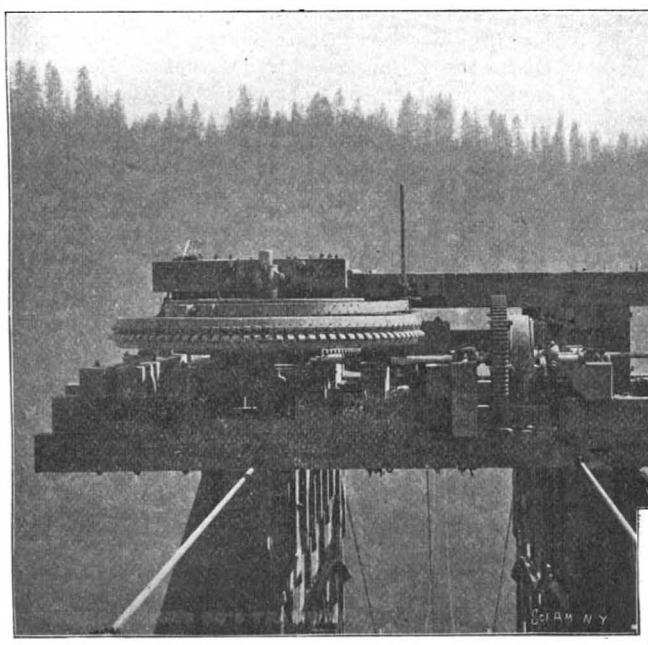
In the higher altitudes of the Sierra Nevadas in California are some of the most magnificent forests of sugar pine to be found on the western continent. The difficulty of marketing the product is intensified by the many natural obstructions which are characteristic of this region. The timber lands are intersected by deep and precipitous cañons or gorges over which the timber has to be carried before the railroad is reached, an operation expensive and extremely liable to accident. An instance is the case of the Eldorado Lumber Company, a San Francisco corporation owning an immense tract including thousands of acres of splendid timber on the South Fork of the American River in Placer County. This river is the largest affluent of the Sacramento. Years ago the lands were owned by a company which expended a million dollars in building dams on the river and constructing railroads to connect with the main lines at Placerville, but floods carried away the dams and obstructed the railroad.

After many years of disaster, the original company succumbed and the present organization succeeded to all its rights and privileges. Some of the most valuable of the timber lands on the tract are separated by a deep gorge of the American, having in this instance a breadth of only 2,650 feet at a height of 1,000 feet above the river bed. Formerly lumber had been transported over this depression by a cable tramway extending up the sides of the mountain and crossing the river by a suspension bridge. This plan, successful for a time, was slow and expensive as well as dangerous in the extreme, and it was determined to abandon it for a less objectionable plan, if engineering talent could be found that could suggest one. Mr. Edward J. Parsons, C. E., of the California Wire Works, devised the method of overcoming the difficulty, which was adopted and has now been installed. All difficulties attending the transportation of lumber in carload lots have been surmounted. Two cables each 3,000 feet long and 1 7-16 inches in diameter were thrown across the cañon. Each weighs 14½ tons. The cables are constructed with a solid wire core ½ inch in diameter, around which 57 wires, each 0.154 inch in diameter, are twisted in opposite layers of 13, 19 and 25 strands respectively. The cables have an ultimate strength of 125 tons and are anchored in solid rock. Two tunnels were driven for over twenty feet into the solid granite and at the end the cables are fastened into heavy castings and anchored into tons of solid concrete. Connecting rods are threaded throughout their entire length, so as to regulate the slack and restore the equilibrium of the cables when disturbed, thus maintaining at all times a constant level. Though the velocity of the wind in exposed places in the high Sierras is often great, yet the cables are but little affected.

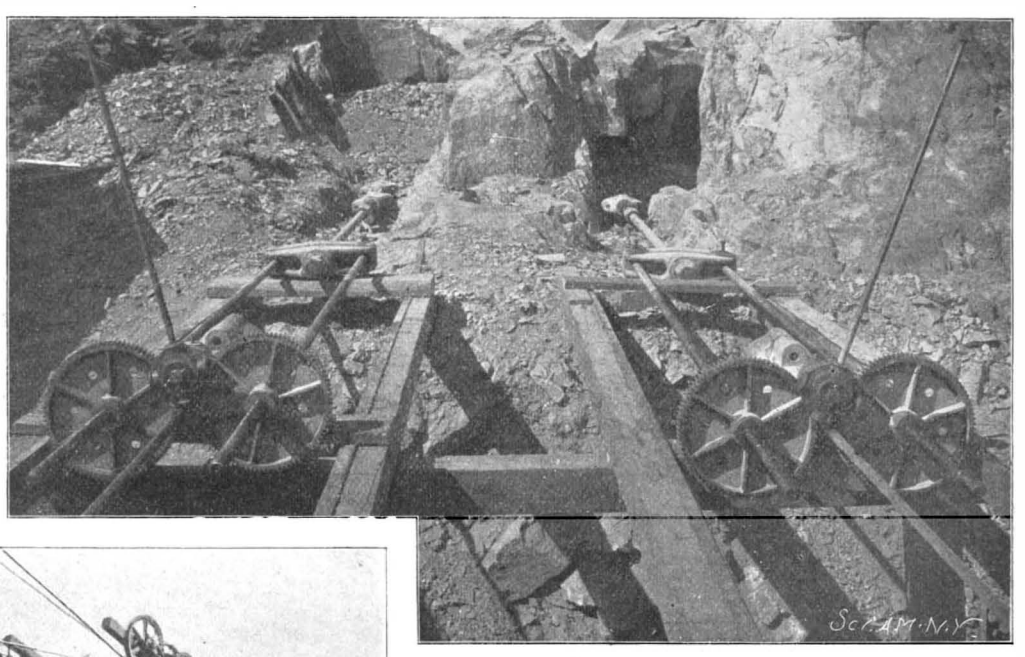
The engine, clutch wheel and connections are placed at the north end of the cable and the cage is operated from this point by an endless wire cable passing around a sheave at the south terminal which is 35 feet lower than the engine. The transmission cable is held and operated by horizontally placed wheels. In case of accident to the cables these clutches would enable the car to be drawn to the nearest or either terminal.

The skeleton cage in which the car of lumber is transported is of steel and it travels on the cables by eight deeply grooved wheels. The rails upon which the car of lumber rests connect with the roadbed at either terminal.

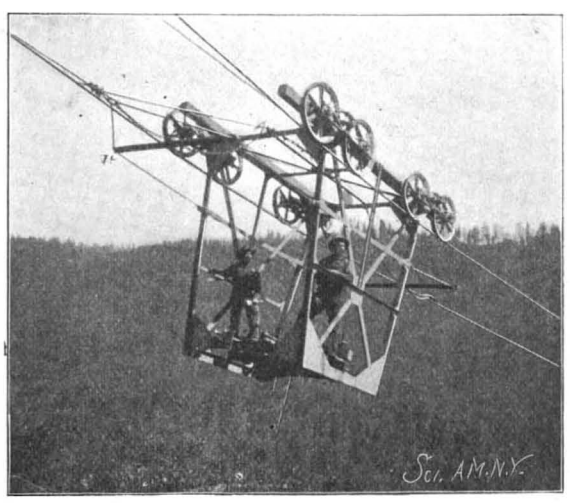
Clutches hold the car wheel securely in position. The cost of the improvement was less than $12,000, and the success of the enterprise is assured.



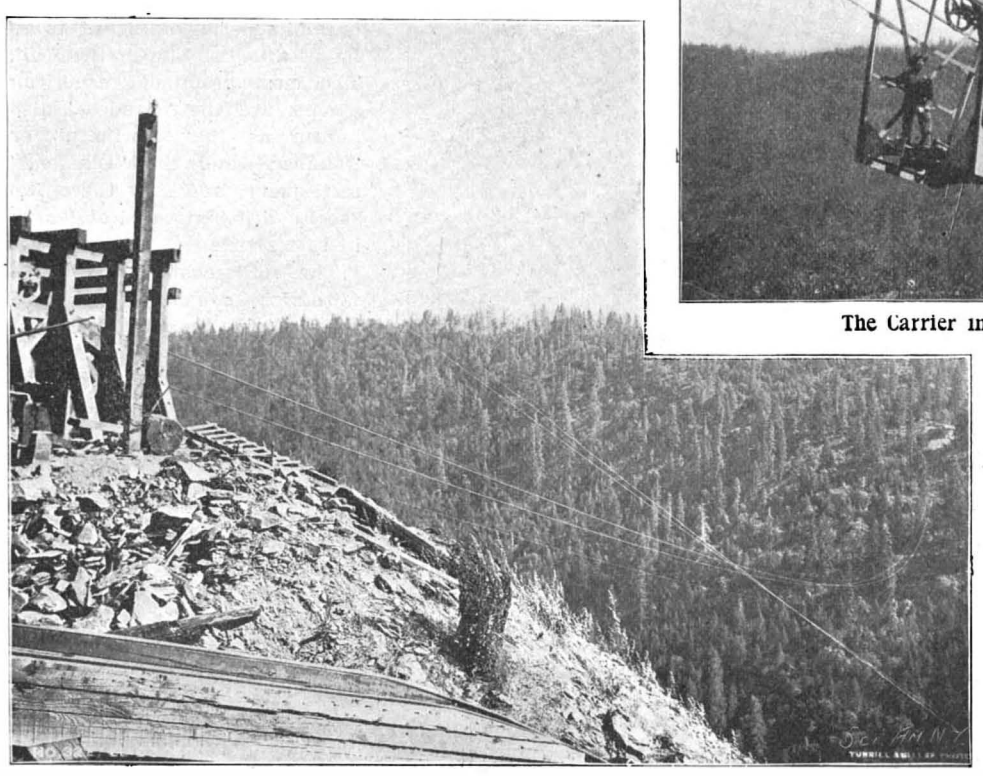
The Large Sheave.



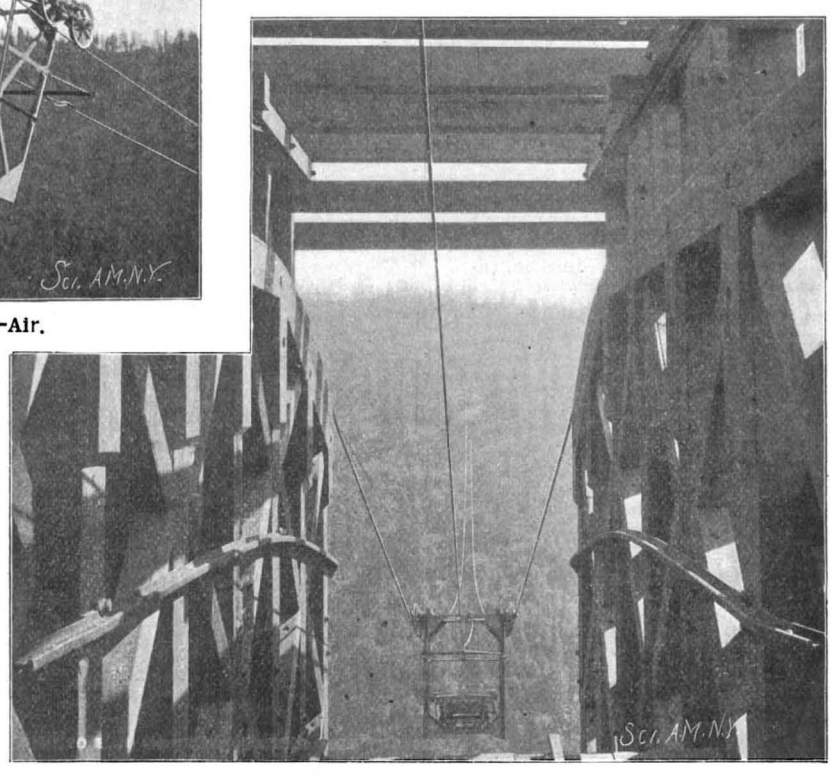
Anchorage and Tightening Devices.



The Carrier in Mid-Air.



Head House and Cables.



View of Tramway Looking Through the Head House.

Much interest is manifested in the offer of a $3,000 cash prize by the World's Fair authorities to any person who shall successfully transmit without wires electrical energy amounting to one-tenth of a horse power 1,000 feet. This achievement, if performed, would mark a new step in the development of electrical science. Many experiments have been made in the direction suggested.

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VENOMOUS SERPENTS.—I.

BY RANDOLPH I. GEARE.

It is probably safe to say that the average person cannot tell a venomous from a non-venomous snake, by mere observation, and knows but little as to the character of the venom, or how snake-bites should be treated. Many a life might have been saved, had specific knowledge on these points been generally disseminated.

At the outset it may be well to state that, so far as North American snakes are concerned, nearly all those whose scales on the under side, from the vent backward, extend in one row across the body are poisonous; whereas, those which have a dividing (median) line, and a row of scales on each side of it, are non-poisonous.

In North America, omitting Mexico, there are about one hundred and sixty-five species of snakes, of which some twenty (counting the several kinds of rattlesnakes) are venomous. These include the Elpids, or Coral Snakes; the Copperhead (*Agkistrodon contortrix*); the Water Moccasin (*Agkistrodon piscivorus*); two species of Sistrurus (*Sistrurus miliarium* or Ground Rattler, and *Sistrurus catenatus* or *Massasauga*); and a number of species of Rattlesnake (*Crotalus*), such as the Dog-faced Rattlesnake (*Crotalus molossus*), the Banded Rattlesnake (*Crotalus horridus*), the Diamond Rattlesnake (*Crotalus adamanteus*), the Texas Rattlesnake (*Crotalus atrox*), the Red Diamond Rattlesnake (*Crotalus atrox ruber*), the Pacific Rattlesnake (*Crotalus lucifer*), the Tiger Rattlesnake (*Crotalus tigris*), the Horned Rattlesnake (*Crotalus cerastes*), the Green Rattlesnake (*Crotalus lepidus*), the White Rattlesnake (*Crotalus mitchellii*), the Red Rattlesnake (*Crotalus mitchellii pyrrhus*), and Price's Rattlesnake (*Crotalus pricei*).

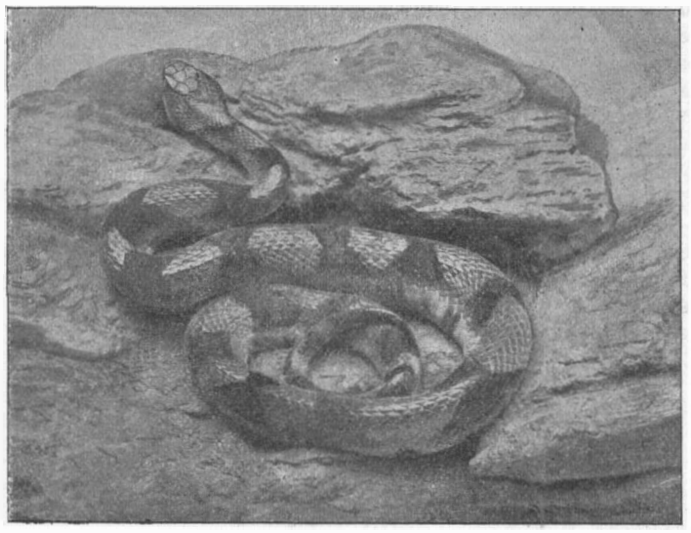
The Coral snakes are very retiring in their habits, and are possessed of a gentle and amiable temperament, but when greatly provoked, they can inflict a bite much more venomous than that of a rattlesnake or moccasin of the same size.

The habits of the Sonoran Coral Snake are not yet well known. It belongs to the "Lower Sonoran" province, but seems restricted to the regions east of the Great Colorado River and west of the Continental Divide. It has been found as far north as Fort Whipple and at certain points in southern Arizona, extending south into Mexico, at least as far as Batopilas, in the State of Chihuahua, in the interior, and to Guaymas, Sonora, on the Gulf of California. The fore part of the head of this snake is black. Back of this is a yellow or creamy white ring, and behind this, a broad light brick-red ring involving eleven scales. Next to this is another creamy-white ring, followed by a black ring eight scales wide. Behind this come black and red rings, alternately, these being separated by white rings. In brief, there are eleven black and eleven red rings on the body, separated by twice as many white ones. The tail is ringed with black and white, without any red.

Strange to say, the Coral snakes are closely related morphologically with the Cobra of India (*Naja tripudians*); that is to say, they agree closely with that deadly group of serpents in external and internal structure, although so utterly dissimilar in general appearance.

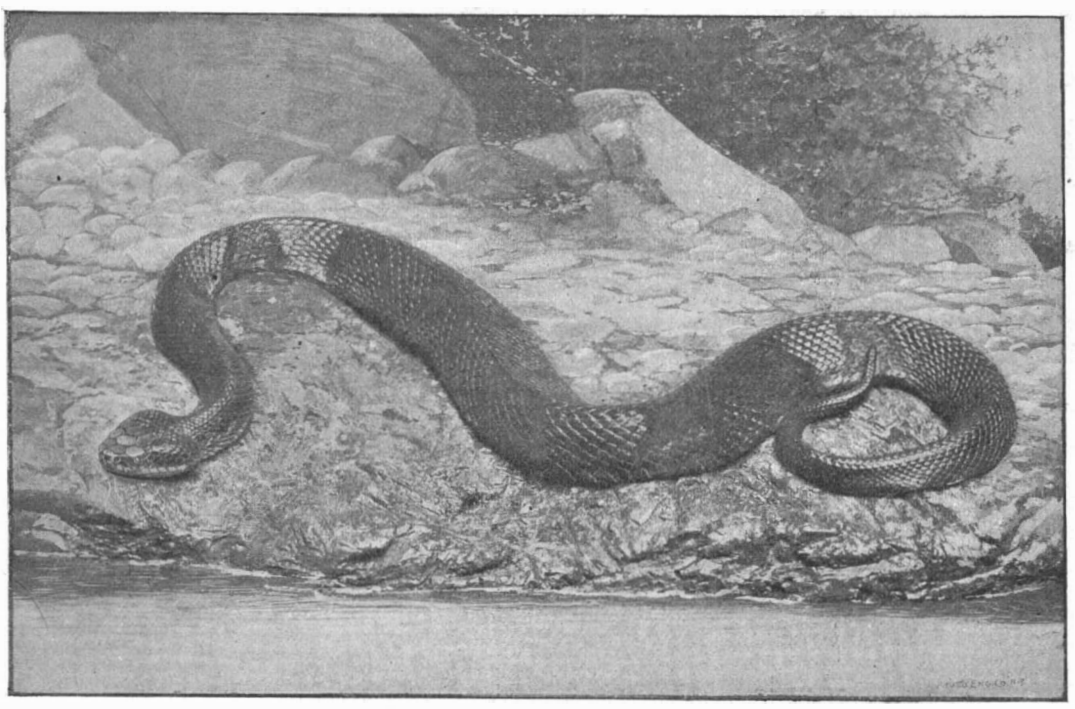
Apart from the Coral Snakes, all other North American venomous snakes may be classed under the name of Pit Vipers or Crotalids. The word "pit" relates to the deep depression found in rattlesnakes, copperheads, and moccasins on both sides of the face between the nostril and the eye Furthermore, this characteristic applies only to the Crotalids, and its presence at once places the serpent in the "dangerous" category. The true use of this "pit," which extends into the maxillary bone, does not seem to have been definitely discovered, but Prof. Leydig regards it as the organ of a sixth sense, from the fact that he found it was supplied with a thick nerve, somewhat analogous to that of the retina of the eye or the labyrinth of the ear. Of late years there has grown up quite a strong tendency to regard the "pit" as an auxiliary auditory organ.

The Copperhead, also known in different localities by the names Upland Moccasin, Chunkhead, Deaf Adder, Pilot Snake, etc., is perhaps to be more dreaded



A COPPERHEAD.

than any other American snake. Not having a rattle, it cannot sound an alarm, even if it wanted to, and its danger is increased by the fact that its movements are rapid—much more so than those of the rattlesnake, than which it is also much more aggressive. There is some comfort in the assurance that its poison, in proportion to the quantity, is less virulent and its bite less dangerous than that of the Rattlesnake. The body of the Copperhead, which species seldom exceeds three feet in length, is strong and thick, ending in a short tail provided underneath with a row of shields. The color of the upper parts is a beautiful coppery brown, becoming lighter on the sides, with dark-brown spots of a characteristic hourglass-shaped form. It generally inhabits low ground and is found from the 45th parallel of north latitude to the extreme south of the eastern United States. It produces its young alive, like all other crotalids, the average number of the members of a family ranking from seven to nine.



ADULT WATER MOCCASIN.

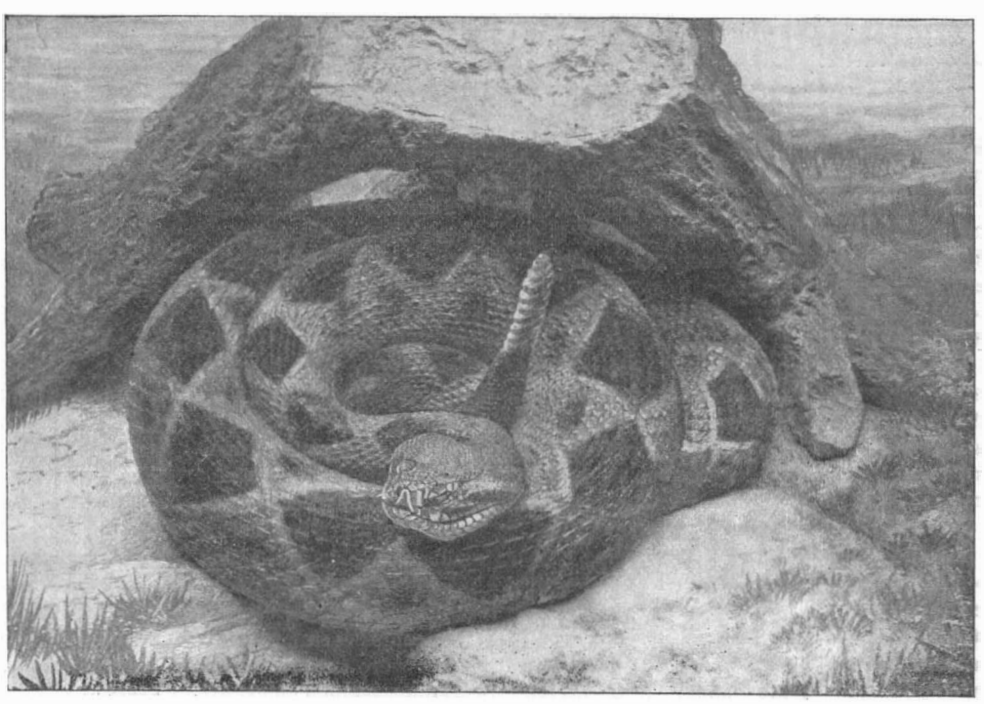
The Water Moccasin (*Agkistrodon piscivorus*), which seldom exceeds four feet in length, is a very venomous snake, and is more to be dreaded than the Rattlesnake, as it will attack anything and everything on sight, and without apparent provocation. With its mouth wide open, it erects itself boldly and darts forward with a rapid spring. Its color is a greenish brown, and it may be recognized by a number of dark bands somewhat similar to those of the Copperhead. Its range extends southward from North Carolina; over the whole of North America, and westward as far as the Rocky Mountains. This serpent is especially plentiful near rivers, marshes, and in swampy lands. According to one authority it delights in climbing trees—apparently for the pleasure of basking in the sun. It is reported that some specimens in the Zoological Garden in Berlin became very tame and gentle toward their keeper, who finally handled them without fear. They would take their food—fishes or even raw meat—from the forceps held in his hand. Toward other snakes they were very savage, and it is stated that their bite is dangerous to other poisonous snakes, although not injurious to others of the same species.

Most conspicuous among the Pit Vipers (*Crotalids*), which are common to Asia and America, are the dreaded Rattlesnakes. These latter, however, are confined to America. They are distinguished by the jointed, horny appendage at the end of the tail, commonly known as the "rattle." In young specimens the tail ends in a simple "button," which is the last joint of the tail. By the time the snake has reached maturity, twenty or more rings may have been interpolated between it and the scaly portion of the tail.

There are so many kinds of rattlesnakes in this country that it would be tedious to the reader, and superfluous indeed, to attempt a description of them all. The most prominent American species are the "Banded," also known as the "Northern" or "Timber," and the "Diamond" rattlesnake, and only these two species will be treated at length in this article.

The Diamond rattlesnake (*Crotalus adamanteus*) sometimes attains the length of eight feet. This is strictly a southern species, its range being confined to the seaboard below the Carolinas. Its favorite haunts are damp, shady places. It differs from the common rattlesnake in its coloration. The ground color is a beautiful greenish, or occasionally golden brown; upon this is a triple lozenge-shaped chain-pattern on each side of the back, the golden yellow lines of which stand out in marked contrast to the dark diamonds of the ground color. A blackish-brown band runs from the muzzle through each eye to the corner of the mouth; and the top of the head is either uniformly colored, or ornamented with irregular markings.

(To be continued.)



THE DIAMOND RATTLESNAKE (CROTALUS ADAMANTEUS).

The excavations that have been carried on for some time past for the discovery of the Temple of Venus on the ridge of Mount Kotilyon, in Arcadia, have resulted in partial success, by the unearthing of a portion of the edifice. Pausanius speaks highly of this temple, and its discovery is of great importance from the archæological point of view. A marble slab bearing the inscription "Pan, Artemis, and Apollon" has been brought to light in the course of the excavations, which were made under the superintendence of M. Kourounioti, inspector of antiquities, and sent to the Ministry for Public Instruction. It is assumed from this inscription that, besides the Temple of Venus, of which Pausanius speaks, another temple dedicated to these ancient deities, must have existed in close proximity.

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Legal Notes.

PATENT OWNERSHIP BY ORAL AGREEMENT.—Frank B. Cook brought an action against the Sterling Electric Company in which principles of law are involved that should be studied by every inventor. Frank B. Cook alleged that he was the first and original inventor of a certain telephone switchboard patented on January 16, 1900. He claimed that the defendants infringed on his patent. In reply the defendants stated that Cook, prior to the issuance of the patents, made an agreement with the defendants, the Sterling Electric Co., whereby he granted to the Company the exclusive right to make, use and sell, and to license others to make, use and sell, the switchboards which he had patented, during the full term of seventeen years. In consideration of the granting of this exclusive right the Sterling Electric Company claimed to have transferred to Cook 400 shares of its capital stock, valued at $40,000, together with $8,000 in cash. Since the making of this oral agreement, the defendants alleged that Cook had repeatedly stated orally and in writing that the Company had been authorized and exclusively licensed to work his patent during its entire term.

The court entertained no doubt that an oral agreement for the sale of an invention, founded on a sufficient consideration, made pending an application for a patent, is valid in equity and constitutes a good defense to a suit brought by such inventor after he has obtained a patent for the invention. The inventor of a new and useful improvement acquires thereby no exclusive right to it until he obtains a patent. The exclusive right is created by the patent, and no suit can be maintained by the inventor against anyone for using it before the patent is obtained. But the inventor of a new and useful improvement is vested by law with an inchoate right to its exclusive use which he may perfect and make absolute by proceeding in the manner which the law requires. Cook possessed this inchoate right at the time the oral agreement of sale was made. The invention had then been made and an application was pending to obtain a patent.

This inchoate right to the exclusive use of the invention was a property right and the subject of bargain and sale unless forbidden by the statute. The statute (Section 4898 R. S. U. S.) does not prohibit such bargain and sale. It applies solely to the assignment, conveyance or grant of a patent or an interest therein, and not to the sale of the invention before the issuance of a patent. The statute does not profess to deal with the invention until the inchoate right to its exclusive use has been perfected and made absolute by the obtaining of a patent. Before the patent is granted, the sale of the inchoate right to the exclusive use of an invention is governed by the general principles of the law relating to bargains and sales.

The case of Gayler v. Wilder, 51 U. S., 477, decides that the inchoate right to an invention may be sold and assigned before a patent therefor has been granted. In that case, it is true, the assignment was in writing, but unless a right of property existed in the invention before the patent was issued, the assignment would have been invalid for want of a subject-matter on which it could operate. In this country, where the principle of the patent laws is recognized, where an invention is regarded as property which may be set apart for a person's own exclusive use, why is it not assignable without an enabling statute? What reason can be assigned why an invention which is regarded as property shall not be transferable like other property, there being nothing in the statute to prohibit it? The court thought it could be done. An oral assignment of invention, before the issuance of a patent therefor, is valid, and invests the purchaser with the equitable title, and the inventor who, after such assignment or sale, obtains a patent, holds the legal title in trust for the owner of the equitable title.

The cases [referring to citations omitted here] establish the doctrine that an oral agreement for the sale and assignment of the inchoate right to the exclusive right of an invention before a patent has been granted therefor is not within the statute of frauds, nor within Section 4898 of the Revised Statutes, requiring the assignment of a patent or of an interest therein to be in writing, and that such an agreement may be specially enforced in equity upon sufficient proof thereof.

It is claimed that whatever may be the equitable rights of the defendants under the agreement, the legal title is in the complainant and that the oral agreement cannot be set up as a defense, and that the defendants should file a bill setting up their equitable rights and compel a transfer of the legal title.

It suffices to say that this contention overlooks the fact that this is a suit in a court of equity, where, in matters within its jurisdiction, an equitable title is as good as a legal title as to all parties affected by such equity. It cannot be maintained in a court of equity that a party holding the equitable title will be denied his equitable rights by the holder of the naked legal title. In such a case the holder of the legal title stands, in a court of equity, as a mere trustee for the use and benefit of the owner of the equitable title or estate. It certainly would be against conscience to permit a complainant, while holding the consideration for the oral agreement of sale, to pursue the defendants as wrong-doers.

The plea was allowed as sufficient, with leave to the complainant to reply thereto, if so advised, within 20 days; failing to reply, the bill to be dismissed.

SOME AMENDMENTS TO THE PATENT LAWS.—American inventors and manufacturers have since May 30, 1887, when the United States became a signatory to the International Convention for the Protection of Industrial Property, been able to claim, within prescribed periods, the dates of the filing of their United States patent and trade-mark applications as their dates of priority in the other countries which are members of the Convention. The articles of the Convention have now been amended, and the period during which inventors may claim priority under the rules has been greatly enlarged. Amendments have also been made which will aid manufacturers and merchants to more fully protect their trade-marks abroad.

The most important amendment is the extension of the time in which inventors may file their patent applications in the countries which are members of the Convention. Under the old rules this time was six months, counting from the filing of the patent application in the home country, with an allowance of an additional month for the citizens and subjects of countries beyond the sea. Article 4, as it has been amended, extends this time in all cases to twelve months, counting from the filing of the home application. Provided an inventor files his patent application in the countries which have signed the Convention within this extended time, he will enjoy a right of priority which will not be invalidated by acts accomplished in the interval, such as the filing of an application by another, the publication of the invention or its exploitation. This is very important to American inventors, as the laws of many foreign countries, unlike the law in the United States, make it necessary to file a patent application under an earlier date than that on which the invention becomes publicly known in said foreign countries, or is disclosed in public print in any country. This provision is also especially beneficial to American inventors, for in most foreign countries patents are granted to the person claiming the earliest filing date, whether he is the inventor or not. The effect of this feature of the foreign patent laws is seldom fully realized by applicants who are accustomed to our American patent procedure and who believe that the first inventor is always entitled to the foreign patents. In many cases, however, subsequent inventors and others who have obtained information concerning inventions have obtained valid foreign patents. With this extension of time in which to file foreign applications, inventors will feel freer to place their improvements on the market on the filing of the United States application, and they will also be in a better position to interest capital in their foreign patent applications. Still, as Germany, Austria-Hungary, Russia, and some other important countries, are not members of the Convention, inventors should remember that the Convention rules do not apply in all the foreign countries.

In the patent laws of many of the foreign countries, provision is made for the commencement of the manufacture of the invention within a prescribed time, but the final protocol annexed to the International Convention, declares that patents shall not suffer forfeiture by reason of non-working, except in cases where the patentee cannot justify the cause of his inaction after three years from the filing of his application. As this provision is remedial we believe that it will be liberally construed.

While the time in which to file foreign trade-mark applications has not been extended for American applicants, the provisions for the protection of registrants' rights have been more carefully drawn, and there has been added a section giving foreigners who are entitled to rights under the Convention all the benefits accorded to citizens or subjects of a country against unfair competition.

The amended Convention was signed on December 14, 1900, and was ratified by the United States Senate and the President last spring. The United States State Department has requested the Commissioner of Patents to take the initiative in presenting to Congress a form of amendment of the United States patent statutes in conformity with the International Convention. The bill has been introduced in the present Congress and is now in the hands of the House and Senate Committees on Patents. But this is as far as the matter has gone, and unless the committees make haste to report the bill so that our patent law may be amended in accordance with the rules of the International Convention without undue delay, citizens of this country will be unable to have the benefits of the Convention rules in the foreign countries, because of our failure to reciprocate. Inventors and others interested in the bill should write to their Congressmen and use what influence they can to have the bill advanced.

THE ROBINSON CAR WHEEL PATENT CONSTRUED.—On November 23, 1897, letters patent were granted to Robinson for an invention, the object of which was to make a composite wheel with the outer portions or sides of one metal, and the inner portions of another, and in the case of pulleys to give to the center of the groove of the pulley a hard or chilled surface, while leaving the balance of the metal soft. Suit was brought by Robinson against the Chicago Railway Company for infringement of this patent.

A study of the patent in suit clearly discloses that Robinson supposed that, when he filed his application for letters patent, the patent carried with it three particular inventions: (1) that he had invented an improved method or process for casting composite or other wheels; (2) that he had invented an improved form of mold adapted to carry out such improved method or process for casting composite or other car wheels; and (3) that he had invented a new wheel or resulting product thereby. Only two claims were infringed, and they claimed a specific construction only. The court was convinced that the patent in suit rose to the level of distinct invention in the production of a composite metallic wheel; but was equally convinced that as to the claims in issue, Robinson had contented himself with covering only a particular mechanical form or combination of mold. adapted to carry out the improved process and to produce the desired wheel product. In these two respects—the improved process and the wheel product—Robinson made a substantial step forward in the practical effectiveness of the molders' art. The defense in substance contended that there was no infringement by construing the claims literally. The court construed the patent in the same light, and held that, although the claims were valid, they were not infringed.

CALCIUM CARBIDE LITIGATION IN ENGLAND.—An important legal decision was recently given in the English Court of Appeals in the case of the Acetylene Illuminating Company (Limited) vs. The United Alkali Company (Limited). The plaintiffs appealed from the judgment of Mr. Justice Buckley dismissing the action, by which it was sought to restrain an alleged infringement of a patent for the manufacture of calcium carbide. The patent, of which the plaintiffs were the owners, was taken out by Mr. Wilson, in 1894. The defendants denied infringement, and made the usual allegations, that the patent was bad for want of invention and novelty. The anticipations cited, were a previous patent taken out by the same person in the United States in 1892, and disclosures in communications by M. Merison to a French scientific institution. The first claim in the specification was for the manufacture of crystalline calcium carbide by subjecting lime and carbonaceous matter in suitable proportions to the continued action of electrically generated heat, and in the specification the patentee said that he employed a suitable electric furnace, such as a Siemens furnace. The plaintiff's case was that the patentee was the first person to show how to manufacture calcium carbide on a commercial scale, and that the patentee was confined to using an electric furnace, so that the current passed through the material but not to an arc furnace, as distinguished from an incandescent furnace. The appeal was dismissed.

RIGHT TO RELIEF IN EQUITY FOR TRADEMARK INFRINGEMENT.—It is an old maxim that a complainant who comes into a court of equity must come with clean hands. The old rule is once more applied in the case of the Preservaline Manufacturing Company against Heller Chemical Company (118 Fed. Rep. 103). The court held that the use by a manufacturer of an article for several years after a patent therefor had expired, of advertising circulars containing the word "patented," or statements clearly implying that it was protected by a patent, which circulars were inclosed in the packages in which the article was sold, is such a fraud as will preclude relief in equity against unfair competition, although no such statements were made in connection with complainant's trademark, or on the packages themselves; it being impossible for the court to determine to what extent the value of complainant's business, which it is asked to protect, is due to such fraudulent action.

Infringement is not escaped by changing the form of the parts of a patented combination without essentially varying the principle or mode of operation of the original invention; but where a new combination of old elements is such that it produces a new mode of operation and a beneficial result, there may be a patentable invention.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

DEVICE FOR CUTTING WEEDS AND STIRRING SOIL.—H. D. Clayton, Edmond, Kans. Mr. Clayton's improvement relates to an agricultural implement used for cutting weeds and stirring soil, and more particularly employed in crops planted with a lister. The machine consists, mainly, of a pair of sleds connected by means of a long board, the sleds being preferably pulled by four horses, and is provided with cutting mechanism for severing weeds and for pulverizing the surface of the soil.

STUBBLE-SHAVER.—T. X. Landry, Labadieville, La. The stubble-shaver is devised to provide an apparatus in which the blades employed may be easily and quickly adjusted to and from the ground and reversed and wherein also the blades will have guided vertical movement. Another provision is a separator for the stubble, placed at the rear of the blades, which separator is provided with a roller to enable it to pass readily over the ground however uneven the surface. The shaver has a light and strong frame and is mounted to move upon runners.

Electrical Devices.

ACCUMULATOR-PLATE.—W. Kraushaar, Neumühl, Rheinland, Germany. In this storage-battery-plate there is provided a leaden plate furnished with ribs of lead cut through at certain points. The cuts are so arranged that the ribs can be separated into small pieces without weakening any point of the plate. By this arrangement of cuts the plate can be cast more easily. The cuts in one strip are opposite the middle point of cuts in the adjoining strips which is an advantage over cuts which go right through the core, as here the lead, as soon as it comes to a part of the core, can flow through the opening in the neighboring rib.

Engineering Improvements.

DRY-VALVE.—J. K. S. Ray and W. D. McNeill, Whitmire, S. C. This invention relates to pressure-controlled automatic valves. It provides a dry-valve for the pipe-line between the main water-supply pipe leading from the reservoir and the water pipes of the system, normally filled with air under pressure. The valve prevents leakage of air and water from the water-supply pipe to the air-filled distributing-pipe and consequent sealing of the valve, thus allowing the valve to open positively on the reduction of air-pressure in the distributing pipe in case of fire.

REVERSIBLE PROPELLER.—J. V. Johansson, Skyrsta, Hammar, Sweden. This screw-propeller belongs to that class in which the blades are arranged to be reversed, so that a vessel may be propelled ahead or astern notwithstanding that the shaft may be turning continuously in one direction. The parts are so arranged that the propeller-hub will not be enlarged to an extent materially to detract from the efficiency of the propeller. At the same time the blades are held rigid and free from idle movement when the propeller is set, thus preventing needless wear of the parts.

BOILER.—A. Jaeger, Jersey City, N. J. The aim of the inventor is to provide a boiler in which will be combined the action of a water and a fire tube boiler with a jacket-chamber receiving products of combustion and heat usually wasted, in which jacket water-tubes are placed connecting with the steam-chamber below the water-line and with the water-leg of the boiler. The boiler sections are made so that perfect communication is established between them, the communications being both water and steam tight fittings.

BALANCED ROTARY ENGINE.—F. P. Huyck, Swanton, Ohio. In this engine the moving parts are caused to balance each other, the packing is rendered more efficient, the working strain is distributed more equally, and a more operative cut-off is provided. These features are materially developed by a novel type of governor having peculiar relation to the cut-off valves, a cored-out webbed piston, and a valve-gear of unusual efficiency.

DRIVEN-WELL DRILL.—M. Ziegenfus, Burns, Oregon. Mr. Ziegenfus's drill comprises a plunger mounted to slide in a perforated cylindrical jacket to which the well-piping is secured. The plunger is provided with a pointed head of larger diameter than the jacket. In operation the plunger is first driven down with a weight and the jacket is next forced down into the hole formed by the plunger head. As soon as water flows in through the perforated jacket the plunger is driven clear of the same and the well is completed.

PNEUMATIC WELL-DRILLING APPARATUS.—H. W. Rank, McDonald, Pa. Means are provided in this invention for operating well-drills pneumatically or by the regulated pulsations of a body of air or other gas, whereby a piston connected with the drill is alternately raised and allowed to fall. A minor feature of the contrivance is the provision of an elastic cushion for causing rebound of the drill and arresting the rebound when required.

PNEUMATIC BALANCING ROPE-TENSION ATTACHMENT.—H. W. Rank, McDonald, Pa. It is the object of this invention to provide an elastic tension attachment for wire ropes of well-drilling apparatus that are subject to sudden and severe strains at each lift or rise of the part to which the rope is connected, so that the lift may be easy at the same time that the momentum of the tools in the downward movement permits a harder blow to be struck than if the attachment were a rigid one. To this end Mr. Rank employs a pneumatic apparatus applied to a walking-beam and other parts such as are usually used in well-drilling.

GOVERNOR AND THROTTLE-VALVE-CONTROLLING MECHANISM.—R. B. Hain, Los Angeles, Cal. The aim of this invention is to furnish certain improvements in that type of engines used for auto-vehicles. The mechanism embodies a peculiar co-operative arrangement of centrifugal governor devices and manually-operatable means both connected with the throttle-valve, and each capable of independent movement for controlling the valve, and other arrangements of parts bearing on the control of speed.

Hardware.

LATCH.—A. Williams, United States Army, Manila, Philippine Islands. This is an improvement in door locks or latches especially adapted for heavy-hinged doors, although it may be used on sliding doors, or other kinds of doors. The object is to provide a latch-operating means by which the hand in gripping and opening the door also operates at the same time or movement to retract the latch and to hold it in an inactive position. The latch may be handled from either side of a door.

Mechanical Devices.

VENDING MACHINE.—F. E. Huxley, Rochester, N. Y. The improvement relates to a coin-controlled device for lead-pencils, slate-pencils, or like articles. In the machine, a casing is arranged with a storage-chamber and a discharging cylinder for articles to be sold; a coin-receiving lever having a slot for the passage of a coin is mounted to swing in the casing; a movable pin in the slot works outward when the lever springs downward; by an inward movement of a push-bar a receiving-lever is moved downward through connections between the bar and lever; gear connections between the push-bar and the delivery cylinder discharge the articles; and a spring moves the push-bar outward upon being released.

LINOTYPE-MACHINE AND MATRIX THEREFOR.—S. Smith, Brooklyn, N. Y. The inventor in this device seeks to overcome the defects common to linotype machines by attaining perfect alinement of the matrices notwithstanding that the lower lugs or other parts may be very much battered by the continual falling of the matrices into the assembler. He does this by providing on each matrix, an alining surface or surfaces, each independent of the surfaces which engage with the assembler as the matrix falls thereinto.

COPY-HOLDER FOR TYPE-WRITING MACHINES.—S. L. Engel, New York, N. Y. Type-writers will find this device a light, simple and effective copy-holder particularly designed to receive and retain a book of notes, so that the holder attached to the carriage and the book will not interfere with the operation and manipulation of the carriage and will hold the copy immediately before the operator, thus avoiding the tiresome side glances needed when the copy-holder is attached to one side of the frame of the machine. The copy-holder may be applied to any type of carriage, and is provided with means for holding the leaves as they are thrown back from the body of the book after the notes have been written.

WASHING-MACHINE.—G. V. Cesinger, Eaglelake, Texas. The novel construction and combination of parts involved in this design, relates to washing machines of the rocker type, and has for its object the provision of simple details of arrangement for a device of the type indicated which adapt the machine for easy operation and effect the cleansing of fibrous material in an expeditious and perfect manner.

TRANSMISSION-GEAR MECHANISM.—R. B. Hain, Los Angeles, Cal. This in general is an invention relating to improvements in transmission-gearing, and seeks more specifically to furnish an improved type of sun-and-planet gear mechanism of a simple and stable construction in which the parts are co-operatively arranged, and to enable the power to be easily, quickly, and positively shifted for producing variable speed motion without jarring or straining the operating parts.

TRACK-LAYING AND SPIKE-DRIVING MACHINE.—F. B. Hewitt, Fort Myers, Fla. This invention relates to machines for laying ties and rails, and for driving spikes to fasten the rails in place, by which the operations may be carried out continuously by automatic mechanism. One part relates to mechanism by which ties may be transported and laid at proper intervals and successively. Another part relates to rail transporting and laying devices to carry lengths of rails and to place them in position on the ties, such devices being partly under manual control, so as to better position and aline the rails. Another part refers to spike-driving mechanisms, one of which drives spikes into ties on opposite sides of each rail length immediately after placing the rail length in position. Each mechanism includes shoes to embrace a rail with means to clear and pass the fish-plates. Such mechanism also includes plungers and feed devices to place spikes in position to be driven and for the heads of spikes to engage foot-flanges.

PROTECTOR FROM FIRES.—Mickel Murry, Morristown, N. J. By means of this mechanism the inventor has produced a protector which is capable of being operated with very little labor, and instantly upon discovering a fire and by means of which the fire will be hampered, if not completely extinguished at the outset, and an alarm will be sent to the fire department or other persons interested. The spray tank is directly connected with the water-main or other source of supply. It is intended for use particularly in suburban buildings, but is also applicable for service in cities.

Miscellaneous Inventions.

CONVERTIBLE SUSPENDERS AND BELT.—D. Lauferty and B. Stein, New York, N. Y. This invention has for its object to provide novel details of construction for suspenders that adapt them to be quickly and conveniently arranged for use as a body-belt and again converted into suspenders, as occasion may require. A practical feature of the invention is the construction and arrangements of parts whereby improper friction and wear are prevented, and the suspenders are adapted to yield easily to change in the position of the person wearing them.

COTTON-TIE BUCKLE.—P. L. Howlett, Giddings, Texas. By the provision of a simple, strong and cheap buckle, in which the band or tie can easily be slipped or fitted and which will hold the tie so securely that it cannot become displaced and detached from the buckle, Mr. Howlett overcomes two objections to the common styles of bale-ties now in use, the most serious of which is that the looped and short end of the tie is liable to slip or work loose, while the other objection is that the tie must be threaded through the slot or eye of the buckle.

COMBINED TWEEZERS AND MAGNIFYING-GLASS.—F. J. Boehm, Brooklyn, N. Y. This combination tool is made so as to be easily carried in the pocket. Its parts are so combined that when folded the lens will be housed and protected by the members forming the tweezers. The lens is detachably and foldably connected to an arm which is pivoted for adjustment relative to the tweezers, and means are provided by which these features of the lens may be separately obtained. The tool is especially useful in locating and extracting splinters, etc., and in the examination of work.

SWING.—C. B. McKay, New York, N. Y. In this form of teetering swing, the aim is to provide a device having a single swinging beam with cars or passenger-seats at opposite ends so connected as to always maintain a vertical position, to provide in connection with the beam a weight quickly and easily adjusted to cause a balance of the beam when the opposite ends are sustaining different weights; and still further to provide for checking the momentum upon the beam approaching or reaching the desired angles.

SELF-CLOSING VENT AND INDICATOR FOR STORAGE-CASKS.—J. G. F. Hieber, Spokane, Wash. This improvement consists in a special indicator and self-closing vent, and is adapted for use on casks or vats employed in breweries for storing beer. To obviate the expensive loss of beer incident to overflow at cask-vents, the inventor has created a combined self-closing valve and peculiar drop tube which, in addition to automatically stopping all vent of air from the vat or cask, will indicate proper working of the vent.

STEAM-COOKER.—W. S. Hunt, Owosso, Mich. Mr. Hunt's improvement offers a simple device wherein food may be quickly and thoroughly cooked, and one which may be used in conjunction with an ordinary tea-kettle. Steam from the kettle passes up into the cooker by means of a tube. It is thence deflected downwardly and passes through the food placed in the receptacles, then out through side perforations and upwardly through outside vertical eduction tubes.

CUSPIDOR.—W. R. McClanahan and C. E. Bell, Terra Alta, W. Va. The design of the inventors is to improve cuspidors, especially those intended for use in cars and similar vehicles and in such places as hotels, offices, etc. In operation the device is self-dumping or draining, and is always closed except when positively worked to the open position, from which position it automatically closes when the pressure of the foot is released from the rocker.

BOOT OR SHOE CLEANER.—D. McEachern, Rossland, Canada. This cleaner provides a novel construction both of brush and of framing, and the device includes a casing for inclosing the portions of the brush not in use. The invention provides opposite brushes that incline or converge toward each other so that the brushing-surfaces conform to the rounding surface of the shoe and will brush as the shoe is pushed between the bristles.

TRIGGER-TONGUE FOR TRAPS.—H. H. Dreyer, Sentinel Butte, N. D. The purpose of this invention is to so construct a trigger-tongue that the trap when set may be covered by earth and leaves without interfering with the trip action of the tongue. The tongue is so shaped that it will sink in the ground under a very light weight and will offer a knife-edge to the surface of the ground, thus preventing stones, chips, etc., from hindering its action, and insuring the springing of the trap when the animal is above the tongue at any point in its length or breadth.

PLACKET-CLOSER.—Emma Falkenberg, New York, N. Y. Means are provided in this improvement for closing the vent or placket of ladies' dress-skirts, and the object is to provide a very convenient device which may be readily secured to the inner surface of the dress at the side edges of the placket, and be adapted for an instant closure of the vent-opening by pressing the closing device at its side edges. The closing device is released by an upward pull on a flexible connection.

RESPIRATOR.—J. W. McNary, Dayton, Ohio. This improvement is equipped to enable a user to breathe fresh outside air in rooms, railway cars, officers, etc., without exposing the person to drafts of cold air incident to the opening of a window or ventilator. The device is mainly intended for those afflicted with lung diseases, but is available for use in shops or laboratories holding impure air, gases, and the like. It may be used while reading or sleeping.

REFRIGERATOR.—H. Inman, Keokuk, Iowa. This refrigerator secures a complete and continuous circulation of air between the storage and ice-chambers, thus keeping the refrigerating-air at a cool and even temperature. In the operation, the air warmed by the articles in the storage-chamber, will pass out through openings and air-passages. This warm air will cause the cold air from the ice to pass downward through the grates and into the storage-chamber, and when this new supply of cold air becomes heated it will pass out through an opening and force more air into the storage-chamber, and thus a circulation of air will be maintained.

APPARATUS FOR USE IN THE PRODUCTION OF STEEL.—E. C. Wills, Rahway, N. J. The inventor provides his new apparatus with means for use in connection with a suitable receptacle, which may be an ordinary iron-foundry ladle, by which to convert the contents of such receptacle into steel by the introduction of air through the agency of a telescopic twyer whose discharge end is introduced into the receptacle. An outlet is so located that particles forced off by the twyer-blast strike against the roof of the cover, so that the lid causes the particles to drop back into the molten metal.

LOCKING-BAR.—J. P. Maginnis, London, England. To prevent articles from being stolen or handled without authority the inventor has patented a locking-bar for use in fastening baskets, mail-bags, and similar receptacles. The primary object of the device is to produce a locking-bar, neat, simple, strong, and efficient, one which may be inserted through a series of loops and rings and then locked in such a position as to frustrate its withdrawal therefrom.

EXHIBITOR.—G. W. Freese, Clinton, Mich. One object of this contrivance is to display goods in stores, such as lace curtains, draperies, and the like, and to exhibit at one time a number of such articles. Another object is to provide means for covering goods after inspection. This is done by this exhibitor which has novel means for displaying goods in a hanging position and for covering them after inspection. It will also facilitate the displaying of goods when examination is desired and return them to position adapted to be rolled into compact form by a special arrangement and operations of the cover.

CONVEYER.—R. Blum, Berlin, Germany. This improvement pertains to conveyers for moving coke and other lumpy material along in a trough or a channel from place to place. The object is to provide a new device, arranged to insure proper cooling of material while moving it bodily without bringing it into contact with the channel-walls, and without danger of crushing or pulverizing the material.

FOLDABLE CLOTHES-DRIER.—J. K. Champ, near Paris, Ky. The invention relates more particularly to that class of clothes-driers or drying-frames that are foldable when not in use; and the object is to construct a device having novel details that adapt it for convenient service, render it strong and durable, and facilitate an adjustment of the frame for its extension and contraction, as required.

SCAFFOLD.—W. L. Clancy, New York, N. Y. This is a scaffold designed especially for the use of painters, masons, bricklayers, plasterers, and other mechanics, which is easily set up for use or knocked down for storage or transportation purposes, and arranged to provide separate running-boards for the mechanic and his helper and a platform for the material, and to allow of easy raising of the running-boards and platform as the work progresses, for the occupants to work with the best advantage.

CONTROL AND GUESTS PAY-CHECK FOR HOTELS, RESTAURANTS, ETC.—M. Geller, New York, N. Y. Controlling and checking the service to guests in hotels and other similar institutions are advantageously secured in this device, which consists of a simple self-contained check so arranged that all errors in charges or receipts and peculations can be automatically, quickly, and infallibly detected and located.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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"U. S." Metal Polish. Indianapolis. Samples free.

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Coin-operated machines. Willard, 284 Clarkson St., Brooklyn.

Inquiry No. 3774.—For makers of rolled zinc for battery purposes.

Dies, stampings, specialties. L. B. Baker Mfg. Co., Racine, Wis.

Inquiry No. 3775.—For dealers of salammoniac and commercial sulphuric acid in large quantities.

Blowers and exhausters. Exeter Machine Works, Exeter, N. H.

Inquiry No. 3776.—For manufacturers of dies and punches for working sheet iron.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 3777.—For makers of small motor castings.

Manufacturers agricultural implements for export. Hobson & Co., 17 State Street, New York.

Inquiry No. 3778.—For pressed brick machinery.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 3779.—For roofing for a gas plant which is fireproof and acidproof.

SAW MILLS.—With variable friction feed. Send for Catalogue B. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 3780.—For makers of springy rubber cushions for billard and pool tables.

We make anything in sheet metal, any shape. Estimates free. Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 3781.—For a machine or device to take a person's measurements from head to foot.

WANTED.—Parties to manufacture patented specialties. The Annetta Manufacturing Co., Pittsburg, Pa.

Inquiry No. 3782.—For manufacturers of leather-board.

FOR SALE.—Broaching or drawing press at a bargain. Pratt & Whitney make. Samuel Hall's Sons, 229 West 10th Street, New York.

Inquiry No. 3783.—For an attachment for boiler cleaners, consisting of an incandescent lamp cord socket with a permanent magnet attached to the back of the socket, adapted to be attached to any part of the boiler.

Automobiles built to drawings and special work done promptly. The Garvin Machine Co., 149 Varick, cor. Spring Streets, New York.

Inquiry No. 3784.—For a device for the rapid manufacture of artificial ice.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 3785.—For a second-hand, foot power. screw-cutting lathe.

Crude oil burners for heating and cooking. Simple, efficient and cheap. Fully guaranteed. C. F. Jenkins Co., 1103 Harvard Street, Washington, D. C.

Inquiry No. 3786.—For adjustable show-case brackets and standards.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 3787.—For the gasoline valve called the "A. P. Brush Mixing Valve."

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 3788.—For a 4½ or 5 Barnes lathe, second-hand in good order.

WATER POWER FOR SALE.—Reliable 1,500 horse power located in State of New York. Owner would equip and rent power. Davidson, Box 773, New York.

Inquiry No. 3789.—For makers of rough and finished castings for small dynamos and gas or oil engines of ½ to 3 horse power and turbines for the same power.

We manufacture anything in metal. Patented articles, metal stamping, dies, screw mach. work, etc. Metal Novelty Works, 43 Canal Street, Chicago.

Inquiry No. 3790.—For the manufacturer of the Magic Darner.

Wishing to add a few desirable lines to a well-established manufacturing business, I should like to hear from inventors having good patents to sell.
J. C. Christen,
Main and Dock Sts., St. Louis, Mo.

Inquiry No. 3791.—For dealers in heading for barrels and kegs.

FOREMAN WANTED.—Must be thoroughly competent and up-to-date. Familiar with die-making and the manufacture of a large variety of small metal goods, and must be capable of independently running a plant employing thirty men. Located in Chicago. State experience and give references. Address F. O., care of Scientific American.

Inquiry No. 3792.—For a brick machine for light power to work on cheap scale.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines, Early Patents signed by Presidents of the United States. Valentine's Manuals of the early 40's. Correspondence solicited. Address C. A. M., Box 773, New York.

Inquiry No. 3793.—For makers of paper bag making machinery.

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Inquiry No. 3794.—For a spiral spring for opening water closet traps.

WANTED.—List of companies that manufacture railway devices for $1.00. M. Wicks, Box 493, Babylon, Long Island, N. Y.

Inquiry No. 3795.—For a gas burner that works by expansion and contraction.

TIMBER SEASONING AND CREOSOTING.—Representative from England with most valuable patent rights to dispose of, will be in New York about middle of February. Seasons timber perfectly in 48 hours and adopted for largest British government contracts. Reply "Timber," c. o. P. O. Box 1816, New York City.

Inquiry No. 3796.—For manufacturers of ice machines.

Inquiry No. 3797.—For makers of and dealers in small engine castings.

Inquiry No. 3798.—For a ¼ horse power, high-grade steam engine.

Inquiry No. 3799.—For makers of canvas trunks.

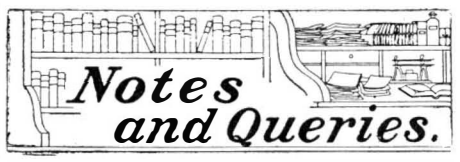
Inquiry No. 3800.—For machinery for the manufacture of spoons.

Inquiry No. 3801.—For machinery for a carpet and rug factory.

Inquiry No. 3802.—For a small air motor or engine with suitable compressor for same, not to exceed ½ h. p.

Inquiry No. 3803.—For a small electric novelty fan.

Inquiry No. 3804.—For parties handling small special shaped pieces of hard fiber.



HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(8824) B. E. Co. asks: What kind of solder can be used to solder iron to iron that will in no way be affected by contact with quicksilver? Are there any other cheap metals besides iron that quicksilver will not affect? A. We know of no kind of solder which would not be more or less affected by mercury. Zinc and lead, which are the only other cheap metals, are both affected by mercury. Copper likewise.

(8825) A. M. says: In the wireless telegraphy transmitter illustrated in your paper of September 14, 1901, you illustrate a coil with a ½-inch spark. How much larger one would be necessary to telegraph 20 miles or so? How many more batteries would you need? Could you use five or six type S Edison-Lalande batteries instead of Bunsen or Grenet? Does increasing the height of the air wire, or putting a copper reflector on the opposite side of the aerial plate from which you wish to send your message, enable you to send a message much further? In your paper of July 5, 1902, you illustrate a receiver. How many more batteries would you need to receive a message from 20 miles or so? To what resistance should the receiver be wound? Is the coherer large enough for that distance? The distance is over land. A. The apparatus for use in wireless telegraphy depends much upon the surface over which the messages are to be sent. It can be said however that a coil giving a 10-inch spark should be able to transmit to a distance of 20 miles over land. Probably six to eight Edison-Lalande cells will work such a coil to full length of spark. If they should not do so, more cells must be added. As the cells run down more will be required than when they are freshly charged. The aerial wire for a distance of 20 miles should be 90 feet high. We are not able to give any data respecting copper plates as reflectors for the waves. The receiver does not need any more battery to receive from one distance than from another. If the signals are strong enough to affect the coherer, they will be received. The receiving apparatus described in our issue of July 5, 1902, does not contain any coil at all. It receives by the ordinary telephone, and the action of the coherer does not depend upon its size, but upon the strength of the signals at the transmitting station. These depend upon the spark of the induction coil and the height of the wires at both stations.

(8826) T. J. writes: Will you please inform me how to bleach yellow feathers white on a live bird? A. Peroxide of hydrogen is the only chemical that can be used on a *live* bird without danger to the animal. This chemical is the one that is extensively used for bleaching hair.

(8827) J. E. R. inquires whether or not a current water-wheel under a 3-foot hydraulic pressure, with paddles 10, 12 or 16 feet long by 3 or 4 feet wide, will run a 12-inch centrifugal pump, elevating water all told 12 feet (total lift 12 feet). The average fall of the stream is 10 feet per mile and it has a velocity of 6 feet per second. The diameter of waterwheel any size you may suggest. What would be the horse power of a current water-wheel, length of paddle 14 feet long by 4 feet wide, and 16 feet in diameter? A. The 14-foot wide current wheel as described should give you 36 horse power, and with a good centrifugal pump should raise 6,000 gallons of water 12 feet high per minute.

(8828) T. W. L. writes: We have a machine in operation used for hulling oats, consisting of metal plates covered with a composition consisting of emery powder, another powder and a liquid. This composition requires constant renewal at considerable expense, and we would be very much obliged indeed if you could give us a formula or put us in the way of securing it. A. One of the best cements for fixing emery to wheels, and much in use, is a thick glue—the best light-colored glue that can be obtained—and a strong solution of bichromate of potassa. While the glue is hot and ready to be used, pour in and stir one tablespoonful of the bichromate to a quart of the glue. Quickly apply to the surface and sprinkle the emery over the surface.

(8829) H. B. asks: At how many revolutions a minute could a solid cast-iron disk be run with safety—the disk having the following dimensions: Diameter, 5 feet 6 inches; thickness at hub, 4 inches; and tapering to ¼ inch thickness at the rim. We mean, of course, if this were running free, and were not acted on by any other forces except centrifugal force. A. The disk may be run at a speed of 550 revolutions per minute with a safe factor of from 5 to 6, depending upon the quality of the iron. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 891, on centrifugal force as applied to revolving machinery; 10c. mailed.

(8830) S. R. D. writes: Some time ago you published a formula for softening steel. A. To make steel very soft, heat to a full red for a few minutes, let it gradually cool until it turns black, then quench in warm water.

(8831) W. L. L. writes: In connection with my planing and lumber mill I have hundreds of tons of sawdust and shavings from the planers that I would like to utilize, but lack the necessary knowledge as to how to do it. I have been informed that you can give me the desired information as to what kinds or forms of petroleum or other material, and what kinds of machines, and where obtained, that it would be necessary to use in working this refuse up into marketable fuel. A. Mill shavings and sawdust have been compressed with coal tar, resin, or anything that will make the material stick together, but have been found too expensive unless other fuel was at very high price. In woodworking factories in the Eastern and Middle States, the whole product of the mill is burned under the boilers by enlarging the fire chamber by lowering the grate. Sawdust drawn to a bin by a fan blower, and wet by a water spray just enough to fix the dust, is shoveled directly into the fire chamber. Clean shavings are much utilized by baling and selling to stables for horse bedding.

(8832) H. N. B. writes: Will you kindly answer the following questions: 1. Would a wooden box, coated thickly with paraffin on the inside, do for a very small storage battery cell in place of hard rubber, or guttapercha, and if not, what could be used to coat the box? A. The wooden box will make a good storage battery cell. The box should be well saturated with the paraffin by a hot iron run over the surface. 2. Could a small 3-foot windmill be used to compress air into a small galvanized iron tank, to supply a blowpipe which is used very rarely, and only for short intervals; if so, what size pump and tank could be used? A. A 3-foot windmill will operate a bicycle pump with sufficient pressure for a blow-pipe. A tank of 3 cubic feet should answer the purpose. 3. How many cells of gravity battery would it take to charge a small two-cell pocket accumulator? A. The number of battery cells should correspond with the number of volts with an excess that you require in the accumulator.

(8833) M. J. L. asks how to ascertain the area and square inches and pounds upon the seat of an inch and one-half safety valve, that blows at 80 pounds, and how the decimal 0.7854 is got, and what kind of measurement for getting same. A. The area of the safety valve is the square of the diameter multiplied by 0.7854, which is the proportion of the area of a square to a circle of the same diameter. The area multiplied by 80 pounds is the total pressure. See Le Van's book on the safety valve, $2 by mail, which gives full details and computations for pressure, weight, and its place on the beam.

(8834) W. N. P. asks: What metals will expand and contract the most with heat, and at what temperature and to what extent? A. Of the commercial metals, lead, magnesium, and zinc expand most for a given change of temperature. Lead and zinc expand 29 millionths for a change of 1.8 degrees Fahr., while magnesium expands 27 millionths. This is at about 100 degrees temperature. Of course the contraction upon cooling is the same as the expansion on heating.

(8835) F. B. H. writes: 1. If a 16 candle power electric lamp, made to consume 56 watts, is operated on a line where there is a wattmeter connected to measure consumption, will the meter show 56 watts after lamp has been in use an hour? A. A lamp using 56 watts when connected through a wattmeter would cause it to register 56 watts at the end of an hour, and so on for any proportionate time. 2. In the two and three phase alternating systems, where there are three conductors composing the transmission line, it is said that all three wires are active, the pressure being the same between any two. Now, what I want to know is: how does the current return, and which one of the three is the negative conductor. A. In an alternating circuit there is no positive and negative as in the direct current. The current flows alternately through the wire. Each wire is plus and minus as many times per second as there are cycles. If 60 cycles, then 60 times a second each wire is plus and 60 times it is negative. There is no neutral wire in the three-phase circuit. The three wires are to be thought of as at the three corners of a triangle and the phases passing from one to the other. The circuit is completed through the lamps or motors as in any other circuit. In a direct current the ends of the line wires are not joined to each other to complete the circuit.

(8836) L. B. asks how red printing ink may be removed from paper. A. Soak pieces of blotting paper in benzine, turpentine, or ether and apply successively, using each time a fresh clean piece of the blotting paper; this is preferable to rubbing with these solvents, as rubbing tends to spread the ink and also to loosen the fibers of the paper.

(8837) J. J. K. writes: Some plates for flat feet are made of spring steel covered with leather. The sweat of the feet soon rusts the plate. I have used paint and shellac, but they do not do much good. Please let me know what I can use to prevent rusting. A. Try a good copal coach varnish. If it can be done, an enamel baked on the plates will give the best satisfaction.

(8838) L. A. H. writes: I have some fine copper gas fixtures which have been finished with a bright thin coating called antique finish. This coating or polish has been destroyed to some extent by flies and other agencies. I would like to know of a process for restoring this polish to its original condition. A. Thoroughly clean the fixtures with benzine if necessary, and polish with any one of the usual polishes in the market. Then lacquer with the best quality of lacquer to be had, applying it in a thin coat with a soft brush.

(8839) G. L. writes: Can acetylene gas and oxygen be burned together in a calcium jet for lime light, the same as hydrogen and oxygen lime light? And if not, why so? And if so, is it any more dangerous or explosive? A. Acetylene and oxygen can be used for the lime light. Hydrogen is now rarely used; ordinary illuminating gas is used, being sufficiently efficient and much cheaper. There is no more danger when using acetylene, provided the apparatus is in proper order, than with either illuminating gas or hydrogen.

(8840) G. C. asks for a formula for the making of a powder which extinguishes fire. A. Bicarbonate of soda, mixed with 5 per cent to 10 per cent of mineral matter to prevent caking by absorption of moisture from the air, is useful. A mixture of dry bicarbonate of soda and dry sal ammoniac, if kept in a dry place, is still more effective. In confined spaces, as closed rooms, a different type of extinguisher is effective. It is based on the principle of fighting fire with fire. The following formula is good: Niter 60 parts, sulphur 36 parts, and charcoal 4 parts.

(8841) F. V. N. wishes a formula for producing a rich, red color on copper, for umbrella mountings. A. A gradually increasing temperature in a hot-air bath will give a series of colors as follows: Light-burnish orange, red-burnish orange, *rose red,* violet, steely white, light yellow, dark yellow. Both duration of heating and temperature affect the color obtained. As soon as the desired tint is produced, cool rapidly in air or by plunging into cold water. Colored varnishes are also used, but their effect is not permanent. There are various chemical ways of producing red browns, but none for a "rich red."

(8842) G. A. W. writes: I have two dynamos which I wish to make over. No. 1 is an 8-light 110-volt machine with speed at 2,880. It is compound wound. Field winding is of No. 28 and 14 magnet wire; the armature is of No. 20 wire, 18 coils and 30 turns to the coil. Size of armature 3¾ inches diameter by 3¼ inches length. I wish to make the speed 1,500 and get the 8-light 110-volt out of it. Can I use a grooved armature core? And what size wire shall I use? How many coils? Can I leave the field windings the same as now? No. 2 is a 20-light 75-volt, speed 2,400. I wish to make this 110-volt, speed 1,200. The winding of this machine is compound; the fields are wound with No. 21 and No. 10 magnet wire. The armature is wound with No. 14 wire; size of armature 4¼ by 6 inches. I wish to use a grooved armature core; what size wire shall I use for the armature, and how many coils? I want to leave the field winding as it is now. A. Since you wish to run your dynamos at one-half the speed and still retain the same voltage, it will be necessary to double the number of coils in the armature and put the same number of turns in each as at present; also to rewind the field, using twice the present number of turns, with wire of one-half the cross section of the present winding. In the shunt coil No. 31 B. & S. will answer the purpose. The machine will not then give the same output in amperes. The proper mode of reducing speed is to increase the number of poles in the field. A four-pole machine may run at half the speed of a two-pole machine for same voltage. You will find plans for one, two, and three horse power machines, four-pole, direct current, drum armature, slotted core, as you wish, in the new book of designs, called "Electrical Designs."

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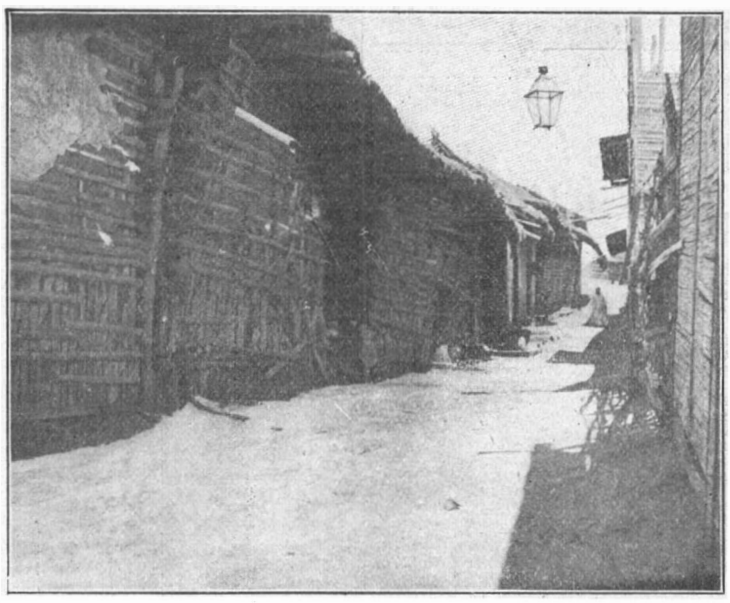
South America and Her Treasures

By JACK ST. ARMONT

SO MUCH interest has been generated of late by the little war cloud which has risen over Venezuela, that the appetite has been whetted for brain food upon the subject of that richest of all countries.

It must be remembered that the population of the country is only about 2,750,000, centered largely about the towns on the coast of the Caribbean Sea on the north borders of the Republic, while the vast interior and southern portion is occupied by a semi-civilized Indian-Portuguese engaged in the gathering of rubber and the Venezuelan cacao, from which comes a large part of our chocolate and of our cocoa, which is of a uniformly superior grade.

The valley of the upper Amazon and its confluents, the Rio Negro and Rio Casiquiare, produce the finest grade of rubber, called Para, on account of shipments being made through the Port of Para at the mouth of the Amazon, in Brazil, for the past sixty years. The forests in the lower Amazon have been so devastated during the past ten years through ruthless tapping and bleeding the trees of all its sap, that the rubber center of the world is now Manaos, on the Amazon, where the Rio Negro empties into it, and the largest standing body of rubber forest in the world is now located on the Rio Casiquiare, a river 175 miles in length, which connects the Rio Orinoco and the Rio Negro. The forests on this river contain millions of trees fifteen years old and over, and now is the beginning of their richest bearing. The phenomenal growth of the rubber trade



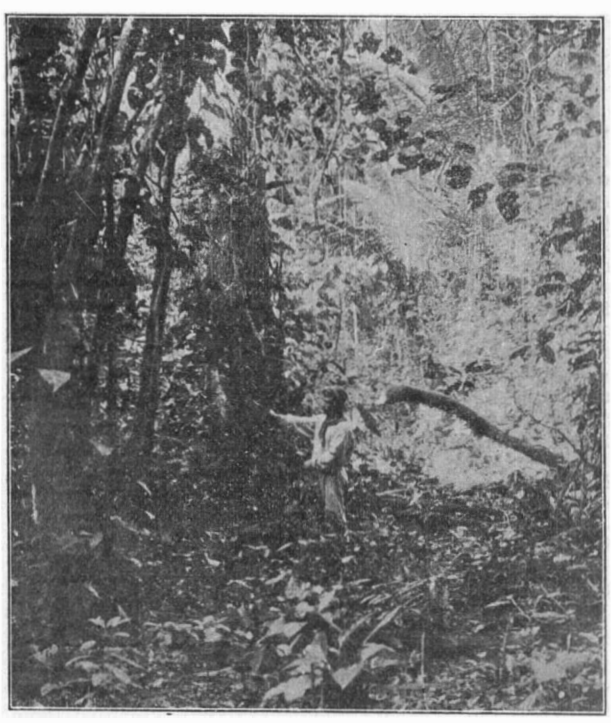
A STREET IN SAN CARLOS

hundreds of useful articles are made from the soft vulcanized product, while from the hard or vulcanite is made buttons, harness trimmings, ink wells, panels for doors, stationery, penholders and innumerable other uses. Elastic in millions of yards, hot-water bottles, steam and water hose are articles of daily and hourly use, while the insulation of electric wiring and appliances has made possible the common use of that great mysterious power, electricity.

Were the new Pacific Cable to be built this year it would take all the visible supply in the United States to-day for insulation. Chroniclers write of this as the electrical age, but historians will write of it as the "rubber age."

For nearly 1,000 miles up the Amazon and the Negro, the country lying tributary holds untold possibilities, which only await the advent of the trading post, conducted on a fairly honest basis, to develop its wonderful wealth. It is the purpose of the Para Rubber Plantation Company to trade with the natives far into the interior, and to that end will send its factors with great stores of merchandise into these regions, where they will be welcomed as benefactors. They will be in a position to barter for the products of the rubber forest and the treasure-trove of this vast storehouse of nature. Operating their own boats, the transportation problem is solved, and the profits possible in this business are limitless. The management of the Company's affairs in the interior is in the most competent hands. Their chief, Mr. Kenneth Rose, has been for years a resident of this country and is a thorough business man and trader. His headquarters are located at the main station of the Company at San Carlos, at the mouth of the Rio Casiquiare, where it joins the Rio Negro. Under Mr. Rose is a corps of efficient men, several of whom could fill his position should the necessity arise, so that by no known possibility could the business suffer through lack of men thoroughly trained for this peculiar work. Every detail has been so carefully worked out and so well systematized as to give ample assurance of absolutely trustworthy and efficient handling of affairs at that end of the line.

It is desired to call the attention of the thoughtful reader of the SCIENTIFIC AMERICAN to the unprecedented opportunity offered to the person of small or large means, and in every walk of life, to so invest his earnings or surplus capital as to insure an income for years to come, and one which will steadily increase year by year, giving a competency for old age, better than life insurance or any other form of assets to be left to the loved ones, a security as stable as a Government bond. The Capital Stock of the Company is divided into 500,000 shares of Common Stock, having a par value of $10 per share, at which price it is offered to the public and for a short time only. There is but one kind of stock; a fortune has already been expended in acquiring the property and establishing trading stations and transportation equipment, and the public is invited into an established business already earning large returns, their money to be used for further developments. It is figured that each tree will produce five pounds of rubber every season, which costs, packed for export, 35 cents per pound, and sells for 95 cents per pound in New York to-day. Two thousand laborers will earn a six per cent dividend upon the entire capital stock, and when it is considered that it will require the 40,000 laborers available to gather the entire crop each season, the figures exceed comprehension. Besides the profit on the rubber one must figure at least 50 per cent net, made on the merchandise traded for the commodity, and the extraordinary profit realized from the trading posts up the river. With this great earning capacity, the selling price of the stock is bound to rapidly increase as soon as the entire project is in full working shape. If 2,000 laborers can earn a six per cent dividend, it takes but a moment's calculation to figure the earnings possible when 40,000 are employed.



NATIVE TAPPING RUBBER TREE

PADRE'S MISSION

has operated to create a popular interest in the Valley of the Amazon, and will lead to a rapid development of its wonderful resources.

There are few undertakings in which a man might engage with greater certainty of enormous and steady profits, than the gathering of rubber on a strictly certified basis. There was used in the United States alone, in 1902, 60,000,000 pounds of rubber, and shipped from the ports of Manaos and Para last year $50,000,000 worth of the crude product—the fame of no other product has made such an impression on the world as Para Rubber. The character of this rubber stands pre-eminent, and it is questionable whether this pre-eminence can ever be wrested from her.

Some two hundred years ago scientific men of India, given to research and investigation, discovered a process for producing a commercial commodity from the cream rising to the top of milk from the rubber tree, and the name India Rubber still clings. Since the genius of Goodyear found a thousand different uses for this rubber, its wonderful commercial value has steadily increased in the number of uses and values. Clothing, boots and shoes, belting, dams for dentists' use, and

A JUNGLE HOME

men went into was the West India Company which made all the principals millionaires. These companies all traded with the natives for the furs or native wild products of their respective regions. The Para Rubber Plantation Company has three distinct sources of revenue: First, the profit on the rubber gathered from its own trees; second, trading in merchandise from the United States for rubber gathered on which the profit will be no less than 50 per cent; third, buying rubber where it can be secured so as to allow a very large margin of profit.

Tapping the wild trees, under competent overseers, and cared for as this Company will care for them, perpetuates the industry for all time, and is the only way by which this most valuable commodity can be conserved.

A prospectus treating of this subject, and all desired information will be furnished on application to F. M. CRAWFORD, Secretary, Dept. R, 52 Broadway, New York City.

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NEW BOOKS, ETC.

THE NAVAL ARCHITECTS', SHIPBUILDERS', AND MARINE ENGINEERS' POCKETBOOK. By Clement Mankrow, M. I. N. A., of Great Britain. New York: D. Van Nostrand Company. London; Crosby Lockwood & Son. 1902. Pp. x, 750.

This work has been written to supply the great want which has long been experienced by nearly all who are connected professionally with shipbuilding of a pocket-book containing all the ordinary formulæ, rules, and tables required by the architect in the working out of the necessary and multitudinous calculations. A characteristic of the work is that while, in the main, it is condensed as closely as possible consistently with giving full data required, many sections of the work are greatly amplified and their value proportionately increased. The diagrams are clear, and the whole work is excellently printed. It may be cordially recommended as one of the most complete pocket-books that have come under our notice.

ANCIENT AND MODERN ENGINEERING AND THE ISTHMIAN CANAL. By William H. Burr, C. E. New York and London: John Wiley & Sons. 1902. 8vo. Pp. xv, 473. Price $3.50.

The subject matter of this work was first presented to the public in the form of six lectures delivered at Cooper Union, in the city of New York, under the auspices of Columbia University. By the desire of the President of the University, the material was prepared for ultimate publication. Part I., devoted to ancient civil engineering works, makes an extremely interesting introduction to the portions of the book dealing with modern engineering. It is richly illustrated with line cuts and photo-engravings, and covers all the more notable and some of the less known works of the engineers of ancient times. Part II., on bridges, contains eight chapters, and commencing with a historical resumé of early bridge building, proceeds through the whole field, and gives a lucid explanation of the principles of bridge design. There are some excellent half-tones and drawings of notable bridges, including the Forth Bridge and the new East River Bridge in this city. This is followed by an equally clear and comprehensive series of chapters in Part III. on waterworks for cities and towns, in which the subject is treated historically. Then the art of modern waterworks construction is very fully explained. The question of the Nile water supply is gone into at some length, and several other notable water works systems in this country and England are briefly described. There is a chapter on "Some Features of Railroad Engineering," in which the most complete description is that devoted to railroad signaling. The work closes with two chapters, one on the Nicaragua and the other on the Panama canal. This portion of the work is of special interest just now, when the Isthmian canal problem claims so much public attention. The advantages and disadvantages of the two canals are set forth, and the matter is so treated that any layman, who reads them carefully, will find himself in a position to judge for himself of the respective merits of the two routes.

SUCCESSFUL ADVERTISING. How to Accomplish It. By J. Angus MacDonald. A Practical Work for Advertisers and Businessmen. A Most Complete Index of Subjects. Philadelphia: Lincoln Publishing Company. 1902.

Advertising is now so very general, and its fundamental principles so well understood, that a book on the subject should not be without value. The volume which lies before us comes from the pen of a skilled advertising agent. After discussing advertisement building in its general aspects, the author refers to retail advertising all the year round. His next topic deals with special features in retail advertising, after which mail order advertising is discussed. Miscellaneous advertising is the subject of his last discussion. The book tells what it has to tell in a clear way. Not the least valuable feature of the book is a list of "Sayings to Swing Trade.

PLUMBING PROBLEMS. Or, Questions, Answers, and Descriptions Relating to House Drainage and Plumbing, from the Sanitary Engineer. New York: The Engineering Record. 8vo. Pp. 244.

A feature of the Engineering Record is its replies to questions on topics relating to water supply, sewerage, sewage disposal, ventilating, heating, house drainage, and plumbing. The repeated answers to inquiries concerning matters often explained in its columns have here been collected into a book, which will doubtless be useful to those interested in sanitary engineering.

THE HOW AND WHY OF ELECTRICITY. A Book of Information for Non-Technical Readers. By Charles Tripler Child. New York: Electrical Review Publishing Company. 1902. 16mo. Pp. 127.

This volume was perhaps the last work that came from the pen of the late Charles T. Child, technical editor of the Electrical Review. Mr. Child presents in the lucid style which characterized all his written work, something of the properties and generation of electricity and something of the methods by which

(Continued on page 124.)

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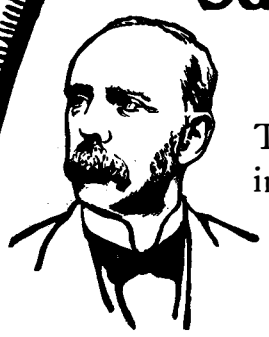

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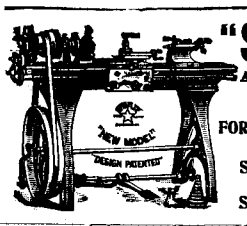

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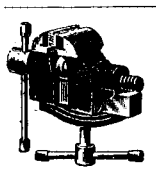

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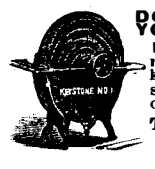

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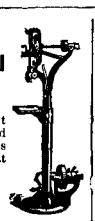

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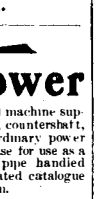

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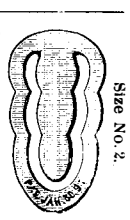

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it is controlled, measured, and made to do man's work. The publishers have seen to it that the book appears in a neat dress.

NATURE AND THE CAMERA. By A. Radclyffe Dugmore. Illustrated from photographs by the author. New York: Doubleday, Page & Co. 1902. Square 8vo. Pp. viii, 126. Price $1.35.

Mr. Dugmore is one of our best known photographers of birds and animals. In the volume which lies before us he has collected what may well be considered the best of his work. To accompany his pictures he has written an instructive text. The publishers should be congratulated upon the admirable manner in which they have issued his work.

THE ART OF SUCCESS. By T. Sharper Knowlson. New York and London: Frederick Warne & Co. 1902. 16mo. Pp. xi, 163. Price $1.

The same methods that characterize the author's "Art of Thinking" will be found in this little volume. The author proceeds by defining success according to its accepted meaning and its applications to various types of successful life. He shows that sometimes there is a success of high quality where dollars are fewest. But since this idealistic kind of success hardly appeals to the multitude, he confines himself largely to what may be termed business success. After considering the difficulties which are met with, he deals with the constructive side of success, the first point naturally being the need of finding a suitable occupation. As concrete examples are often valuable, he devotes an entire chapter to the success of certain well-known modern business men.

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It is just what every minister of the Gospel needs to help him hold the wavering steadfast in their faith, to help him turn the minds of the wicked toward morality, honesty and right doing. It is just what every lawyer needs to help him influence juries, control witnesses and to deliver his argument in that forceful, convincing manner which carries conviction with every word. It is just what you need, no matter who you are or what you do, to enable you to get out of life the success, pleasure and happiness which the Creator intended should be yours. If you are not successful, if you are not making money, it is because you do not know that secret power that rules the thoughts and minds of men. If you are already successful you can become more successful if you will but master the hidden forces around you. Learn to use the secret magnetic power with which nature has endowed you.

Ex-Mayor Kenney's book proves every one is born with this mighty subtle power, that any one can easily develop it at home without the knowledge of his intimate friends or associates, and influence people secretly to carry out his thoughts and ideas. It certainly is a wonderful force, capable of infinite good.

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J. R. Gaskins, Newport News, Va., writes: "I must admit that I doubted very much that hypnotism could be practically taught. In four days after receiving your work, however, you demonstrated to my entire satisfaction that I was never further from the truth in my life. I have met with wonderful success. Your free book is the finest thing of the kind I have ever seen."

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INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending February 3, 1903, AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Accumulator mechanism, M. J. Whitlock.... 719,628
Acid mordant and making same, organic, W. Beckers 719,555
Addition tester, H. E. Brown..... 719,734
Adhesive applying apparatus, A. N. & E. J. Barnes 719,554
Advertising or other purposes, optical device for, R. C. T. Evans 719,771
Alarm system, electric time, E. T. Ackerman 719,551
Aluminium, producing, H. F. D. Schwahn.. 719,698
Animal trap, P. A. Whitney..... 719,544
Asparagus buncher, P. Brunett 719,561
Atomizer, S. Hasbrouck 719,587
Automobile steering gear, A. P. Brush..... 719,562
Baling press, F. L. Heinrich..... 719,591
Ball, K. V. Painter .....719,498 to 719,500
Band cutter, T. N. Huddlestone..... 719,594
Band cutter and feeder, Florence & Misner. 719,777
Battery tank, storage, B. Ford..... 719,778
Bed mosquito bar holder, M. S. Schayer... 719,957
Bed, spring, W. F. Ade, Jr. 719,631
Bed spring, woven wire, Barcalo & Valone 719,635
Belt, apparel, M. Brueckner..... 719,560
Belt idler, W. R. Smith..... 719,895
Bicycle brake, A. E. Wahlin 719,914
Bicycle driving mechanism, J. B. Huss.... 719,595
Binder, H. P. Jones 719,673
Binder, W. G. & H. S. Jones..... 719,674
Bit stock, N. R. Thibert 719,703
Blind slat lock, J. W. Clark 719,648
Boiler, N. Curtis 719,439
Boilers, device for maintaining the water level in, O. Berger 719,424
Book for county records, etc., abstract, J. E. Lutz 719,481
Book, loose leaf, S. Seemann 719,886
Book, manifold sales, H. H. Winslow..... 719,930
Boot or shoe cleaner, L. C. Smith..... 719,894
Boot or shoe trimming machine, E. E. Angell 719,414
Bottle filler attachment, Neubert & Wiedenbeck 719,846
Bottle, non-refillable, Flatten & Ahrens... 719,451
Bottle or jar cap, J. S. Alston..... 719,715
Bottles, jars, etc., protector for, J. W. Steel 719,527
Bottles or glasses, packing for, D. H. Russell 719,612
Box fastener, C. B. Baldwin 719,553
Brake mechanism, J. King 719,813
Brick cutter, B. E. Bechtel 719,722
Brick kiln, downdraft continuous, A. Yates. 719,974
Briquets, manufacture of, E. S. Meade..... 719,830
Brooches, etc., safety catch for, G. W. Washburn 719,919
Brush, automatic bicycle, J. M. Peterson.. 719,608
Brush, bath, L. Lauterbach..... 719,596
Brush cutter, L. E. Gannett 719,784
Brush holder, electric, H. T. Maker..... 719,824
Buckle, trace, J. B. Bunkers..... 719,737
Buggy top attachment, E. Walter..... 719,538
Bulkhead doors, means for operating, P. Hoppe 719,669
Burglar alarm, J. Wagner..... 719,963
Burning liquid fuel, injector or apparatus for, J. Holden 719,801
Butter printing machine, A. Anderson..... 719,413
Button, collar, B. B. Mayer..... 719,828
Button setting machine, Gwinn & Smith... 719,939
Cableway system, F. H. Lamb 719,478
Cabs, front sash supporting and operating apparatus for hansom, W. C. Yelton.. 719,975
Calculator, J. M. Steele 719,701
Calipers, Z. T. Furbish..... 719,783
Candy crimping machine, S. Morgan..... 719,490
Candy dipper, F. C. Spang 719,896
Cape, blanket, and shelter tent, combined, C. Stacey 719,899
Car bolster, hopper, J. M. Hansen 719,464
Car brake shoe, F. R. Spear 719,897
Car, compartment sleeping, H. F. Holland.. 719,802
Car, convertible dump, H. S. Hart 719,796
Car coupling, P. T. Handiges 719,792
Car door, grain, Kuhlman & Woodman 719,815
Car draft rigging, railway, G. P. Ritter.. 719,610
Car, dump, H. S. Hart 719,794, 719,795
Car, dumping, E. S. Hart 719,793
Car grain door, freight, J. Riley 719,875
Car, hopper bottom, I. A. Randel..... 719,868
Car interlocking center bearing, J. E. Norwood 719,496
Car operated door, mine, Flint & Whitney 719,577
Car side bearing, J. E. Norwood 719,951, 719,952
Car transfer, suspended, C. A. P. Turner... 719,979
Cars, radial buffing and draft rigging for railway, H. H. Sessions et al..... 719,519
Cars, etc., side bearing for railway, C. E. Havens 719,589
Carbid blocks or ingots, subdividing, J. Scales 719,882
Carbureter for internal combustion engines, F. H. Messinger 719,486
Carriage, tramway, F. H. Lamb 719,477
Cartridge fuses, electrical contact for, C. D. Platt 719,859
Casting and articles made thereby, C. D. Cannon 719,742
Cattle guard, I. Rimbey 719,509
Centrifugal machine, J. Laidlaw..... 719,476
Chair seat, H. B. Morris 719,601
Check, closure, F. L. Rosentreter..... 719,510
Chimney cap, T. J. Miquel 719,489
Chisel attachment, G. W. Parker..... 719,607
Chlorination barrel, J. B. Hefferman..... 719,664
Churn, Burge & Cornell 719,739
Cigar holder and shaper, S. S. Williamson 719,546
Clock, electric, V. & V. Himmer, Jr..... 719,406
Clutch, V. T. Payne 719,856
Clutch, A. R. Patten 719,954
Clutch, fluid, B. B. Chandler, Jr. 719,746
Clutch, friction, T. F. Carver 719,434
Cock, automatic cylinder, E. L. Jones.... 719,809
Cock, high pressure ball, O. J. Fabian..... 719,447
Coffee pot, A. E. Block..... 719,727
Coffee roasting apparatus, J. Arbuckle..... 719,717
Coin counting device, Goetze & Sanford.... 719,459
Comb holder and cleaner, L. F. Ferrell.... 719,775
Combing machine drawing off mechanism, Lee & Fisher 719,676
Compressor, W. J. Francke 719,454
Condenser, steam, W. Irving 719,671
Conduits, construction of underground, T. E. Devonshire 719,763
Conveyer, A. D. Shaw 719,890
Conveying and cooling apparatus, K. F. Snow 719,524
Cooking utensil, P. J. & E. H. Gates..... 719,786
Copper matte into metallic copper, converting, G. Mitchell 719,488
Copy pad, T. B. Ferguson 719,774
Copying press, H. L. Davidson..... 719,759
Corn snapping, husking, and fodder shredding machines, feed mechanism for, J. O. Thompson 719,962
Couch and chest, combined, G. A. Alger... 719,712
Couch and folding bed, combined, D. T. Owen, reissue 12,078
Crate, folding, A. A. Smith 719,893
Crate, shipping, C. Q. C. Leigh 719,819
Crate, shipping, Shocklin & Schwartz..... 719,891
Crupper former, Bastian & Sussman..... 719,637
Cultivator, G. K. Spitzenberg 719,898
Cultivator attachment, W. L. Schmidt.... 719,885
Cultivator, disk listed, S. D. Poole..... 719,863
Cup. See Oil cup.
Cycles, etc., driving gear for, B. R. Avery. 719,417
Dental crowns, manufacture of, E. V. Williams 719,928
Dental matrix retainer, J. Mills 719,834
Desk shelf attachment, A. J. Throm 719,625
Diaper, infant's, P. E. Kent..... 719,811
Dilator, W. E. Minor 719,487
Dish cleaner, M. D. Colbath 719,936
Disinfecting apparatus, J., W. H., & E. R. Williams 719,929
Display package for powder, shot, etc., C. E. Roberts 719,876
Document holder and exhibitor, C. C. Lee.. 719,597
Doffer guard, J. Kilburn 719,812
Door catch and lock, J. L. Zesiger 719,976
Door operating machine, Macdonald & Warwick 719,682
Door operating mechanism, Warwick & Macdonald 719,917
Door sill, W. O. & F. H. Jewell..... 719,672
Dough cutting and weighing machine, H. P. P. West 719,923
Draft equalizer, H. J. Zempel..... 719,550
Draft equalizer, Campbell & Henderson.... 719,564
Draw gear and buffing apparatus, J. H. McCormick 719,949
Dredging and excavating machine, J. J. Conlin 719,567
Dress shield, D. Basch 719,636
Drill shaper and sharpener, J. Retallack.. 719,874
Drilling machine, E. M. Couch 719,569
Driving mechanism, yielding, Sester & Feldt 719,619
Dumb waiter, J. E. Ortner 719,852
Dust pan, C. W. Hopkins..... 719,943
Electric accumulator plate, A. Bainville... 719,418
Electric battery, H. Halsey 719,660, 719,661
Electric brake, F. E. Case 719,566
Electric condensers, manufacturing, J. A. Wotton 719,973
Electric furnace, H. N. Potter..... 719,507
Electrical distribution system, J. L. Creveling 719,753
Electrical purposes, liquid resistance switch for, J. H. Woolliscroft..... 719,549
Electrolytic apparatus, C. J. Reed, 719,870 to 719,873
Electrolytic cell, R. Gisson 719,791
Electrothermally treating materials, apparatus for, H. Maxim 719,484
Electrotyping, machine for oxidizing matrices for, C. M. Oliver 719,953
Elevator door operating device, J. L. Kail.. 719,470
Elevator safety appliances, electric system for, G. Hail 719,463
Elevator safety device, E. H. Price..... 719,692
Elevator shaft damper, J. A. Craig..... 719,437
Emergency brake, safety, W. T. Sears.... 719,699
Engine lubricator, gas, H. Morningstar..... 719,836
Engine stroke varying mechanism, explosive, A. F. Parks 719,855
Engines, vaporizer or carbureter for explosive, H. W. Tuttle 719,536
Envelope opener or paper cutter, W. O. Thompson 719,906
Exhibitor, A. G. & D. H. McCulloch..... 719,843
Expansion bolt, W. C. Boone 719,426
Explosive engine, J. Willoughby 719,547
Eyeglass nose guard, A. G. French..... 719,780
Eyelet machine, I. W. Giles 719,788
Eyeleting machine, G. Knight 719,475
Fabric marking machine, A. J. Schmiedl.. 719,516
Fan attachment, W. C. Norman 719,688
Farrier's knife, P. E. Heller..... 719,797
Feed box, W. R. Howard 719,468
Fence, hedge, M. Neil 719,605
Fence post, F. E. Gregory 719,789
File binder, E. A. Sharp 719,888
Filter and extractor press, J. G. Crossman 719,438
Filter, oil, Norcutt & Hussel 719,848
Fire alarm apparatus, automatic, H. Plowman 719,504
Fire and burglar alarm, I. S. Bunker.... 719,563
Fire escape, L. Cassanova 719,646
Fire escape balcony, movable, M. L. Cronin. 719,755
Fire extinguisher and alarm, automatic, A. D. Loffler 719,946
Fire extinguishing compound, J. B. Miller.. 719,833
Fire hose coupling, E. Mayer 719,829
Fire kindler, L. S. Murdock..... 719,839
Firearm, magazine, J. D. Pederson..... 719,955
Fireproof floor and ceiling construction, Simpson & Shoemaker 719,892
Fish hook, C. J. Trakel..... 719,704
Fish net, G. L. Plumley..... 719,862
Fish trap, floating, A. C. Burdick..... 719,738
Fishing rod, folding, H. M. McNamee 719,603
Flue, smoke, D. Einstein..... 719,652
Flushing apparatus closet, F. Light..... 719,598
Folding chair, A. D. Truesdell 719,908
Folding gate, J. W. Sharrard..... 719,621
Foliage and making same, artificial, C. E. Akeley 719,632
Foot and body warmer, portable, F. Batter. 719,638
Friction brake, R. R. Osgood 719,853
Fruit picker's receptacle, J. J. Jones..... 719,810
Furnace. See Electric furnace.
Furnaces, cinder or hot metal car for blast, E. A. Weimer 719,706
Galvanic battery, H. Halsey 719,659
Game apparatus, W. C. Farnum 719,448
Game apparatus, D. Gailey 719,456
Game apparatus, F. W. Baynes 719,719
Garbage can or receptacle, E. L. Schiefer. 719,515
Garbage crematory, C. A. Williams..... 719,545
Garbage plant, C. S. Wheelwright 719,542
Garden tool, J. E. Beebe 719,723
Garment clasp, E. H. Gysling..... 719,462
Garment fastenings, card or mount for, O. A. De Long 719,442
Garment sections, marking and folding, P. J. Menahan 719,485
Gas generating apparatus, acetylene, J. J. Hendler 719,665
Gas generator, acetylene, A. Davis 719,570
Gas generator, acetylene, Atkin & Eagleson 719,633

(Continued on page 125)

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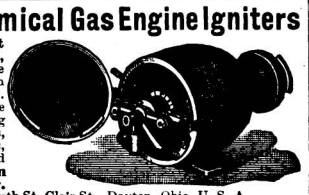

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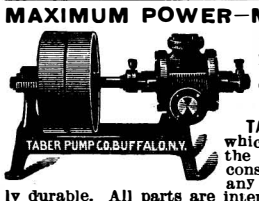

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Gate, J. H. Moss	719,838
Gear wheel, R. E. Evenden	719,572
Gearing, variable speed, J. H. Braithwaite	719,732
Glass shaping machine, W. M. Wolcott	719,710
Glass tile, manufacture of, H. J. Sage	719,511
Glazing conservatories, hothouses, etc., A. Tassain	719,903
Gold separating apparatus for dredging machines, J. H. Gray	719,582
Grinding machine, G. M. & C. J. Luther,	719,677, 719,678
Grinding or sharpening device, I. M. Rose	719,880
Grinding or smoothing machines, apparatus for supplying abrasive material to, D. J. Murnane	719,978
Gun carriage, Behnke & Friese	719,724
Gun, tubular magazine, T. C. Johnson	719,807
Guns, automatic firing apparatus for ships', Von Pechy & Rea	719,857
Guns, two tube gravity charger for magazine, T. C. Johnson	719,808
Hair pin, R. G. Schutz	719,697
Hand rail for moving stair lifts, J. M. Dodge	719,764
Hand rail, moving, J. M. Dodge	719,765
Harness attachment, J. W. Beam	719,721
Hat body drying apparatus, E. Hill	719,667
Hay press, W. N. Newton	719,495
Heat regulating apparatus, Winkenwerder & Swartz	719,548
Heating furnace, H. C. Ryding	719,613
Hide fleshing machine, O. F. Feix	719,773
Hinge, R. S. Bowen	719,640
Hinge, adjustable door, A. Christersson	719,747
Hinge, box, A. B. Miller	719,832
Hitching attachment, vehicle, C. Boulard	719,731
Hogshead cover, G. A. Krieger	719,945
Hoof boot or pad, G. W. Nickerson	719,687
Hook, L. A. Walker	719,627
Hook and eye, G. W. Washburn	719,918
Horse boot, G. H. Weeks	719,922
Horseshoe, cushion tread, A. J. Puhl	719,693
Horseshoeing apparatus, D. E. Kepford	719,473
Hose or pipe mender, R. F. Kunze	719,817
Hose supporter, M. Scheuer	719,884
Humidifying the atmosphere, apparatus for, L. C. Bulkley	719,430
Husking rollers, T. Guest	719,658
Hydrocarbon burner, W. R. Jeavons	719,469
Ice shaver, J. F. Williams	719,966, 719,967
Incubator, J. W. Sauer	719,614
Indicator. See Power factor indicator.	
Indigo, hydrosulfite for reducing, M. Bazlen	719,720
Ink, H. H. Spohn	719,623
Ink well, C. E. Stanley	719,525
Insufflator, S. Hasbrouck	719,586
Insulating high potential apparatus, W. S. Moody	719,600
Ironing table and clothes rack, combined, J. Carroll	719,433
Jars, etc., device for lifting fruit, J. K. Rettig	719,956
Journal box, M. H. De Vore	719,445
Journaling and sustaining device for rotating parts, O. Ohlsson	719,850
Knitting machine stop motion, H. F. Bockmeyer et al	719,728
Knockdown chair, double seat, H. Morton	719,837
Laboratory, pocket, F. Flavitsky	719,776
Lace holder, shoe, C. E. Wettlaufer	719,540
Ladder, extension step, L. Ferguson	719,450
Ladder hook, automatic extension, L. Ferguson	719,449
Lamp, electric, H. N. Potter	719,506
Lamp globes, etc., support for, G. J. Crist	719,754
Lantern, R. Walsh	719,916
Latch, lock, M. Vallee	719,705
Leather, manufacturing artificial, L. G. Naert	719,787
Leather staking machine, H. Roeske	719,878
Life preserver, marine, J. Ewing, Jr	719,654
Lifting jack, Garland & Aiken	719,457
Linotype machine, G. A. Bates	719,422
Linotype machine, J. W. Champion	719,436
Liquids from solids, apparatus for separating or draining, C. S. Wheelwright	719,541
Loading machine, sand, C. Bosselman	719,427
Loading or unloading device, E. C. Starks	719,526
Lock, J. Schell	719,883
Lock and latch, combined, E. Peterson	719,691
Lock attachment, cylinder, W. B. Moore	719,684
Loom, needle, E. Herzig	719,666
Loom warp stop motion, C. F. Roper	719,879
Loom weft feeler, McAuliffe & Bolton	719,491
Loom weft stop motion, J. A. Clark	719,647
Lubricating apparatus, M. B. Hansen	719,941
Lumber, stacking, F. M. Hazleton	719,663
Magneto electric generator mechanism, L. G. Woolley	719,971
Mail box, rural free delivery, H. N. King	719,474
Mail or letter drop, E. G. Gordon	719,581
Malt for mashing, preparing, V. Lapp	719,479
Massage machine support, F. King	719,675
Match box, G. R. Bilz	719,726
Match box for mine lamps, I. A. Sharp	719,622
Match lighter, J. E. Sharpe	719,889
Measuring instrument, B. F. Westcott	719,924
Meat tenderer, O. Pike, Sr	719,858
Merry go round, J. L. McCrea	719,602
Metals, pulverizing, C. Bertou	719,725
Middlings purifier, H. C. Robinson	719,877
Milk cooler, R. H. Casswell	719,935
Milking machine vacuum regulating device, F. M. Devore	719,443
Musical instruments, action for stringed, D. P. & L. F. Boyd	719,641
Neckwear supporter and fastener, O. Kraus	719,814
Nozzle, W. C. Oberwalder	719,849
Nut attachment, spindle, E. Carlton	719,745
Nut, lock, G. W. Brown	719,559
Nut lock, W. Noble	719,847
Oil burner, McDonald & McLean	719,686
Oil burner and feed mechanism therefor, J. W. Anderson	719,716
Oil burner, petroleum, A. F. Demory	719,762
Oil cup, R. L. White	719,543
Oiler, automatic cross head pin, Carlsson & Bohman	719,565
Ore, rock, cement, etc., machinery for crushing or grinding, D. Honeywood	719,804
Ore screening, washing, and assorting apparatus, F. Hermann	719,942
Ore treatment, machine for mixing and storing liquids and gases for, S. C. C. Currie	719,756
Oven, bake, Dowd & Coleman	719,651
Package, storing and shipping, J. M. Hommel	719,803
Packages, adjustable mouth for shipping, C. Q. C. Leigh	719,820
Packing, piston, J. T. Wilson	719,630
Papers, apparatus for drying coated, W. M. Barber	719,931
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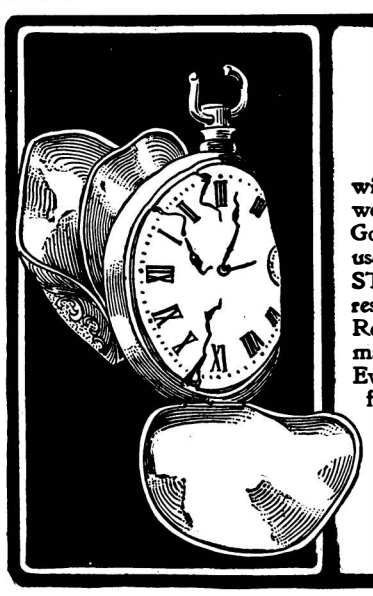

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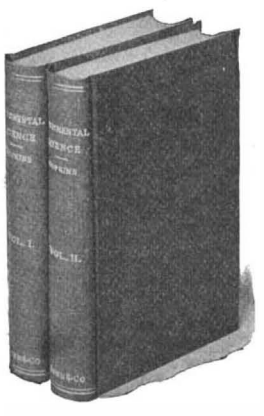

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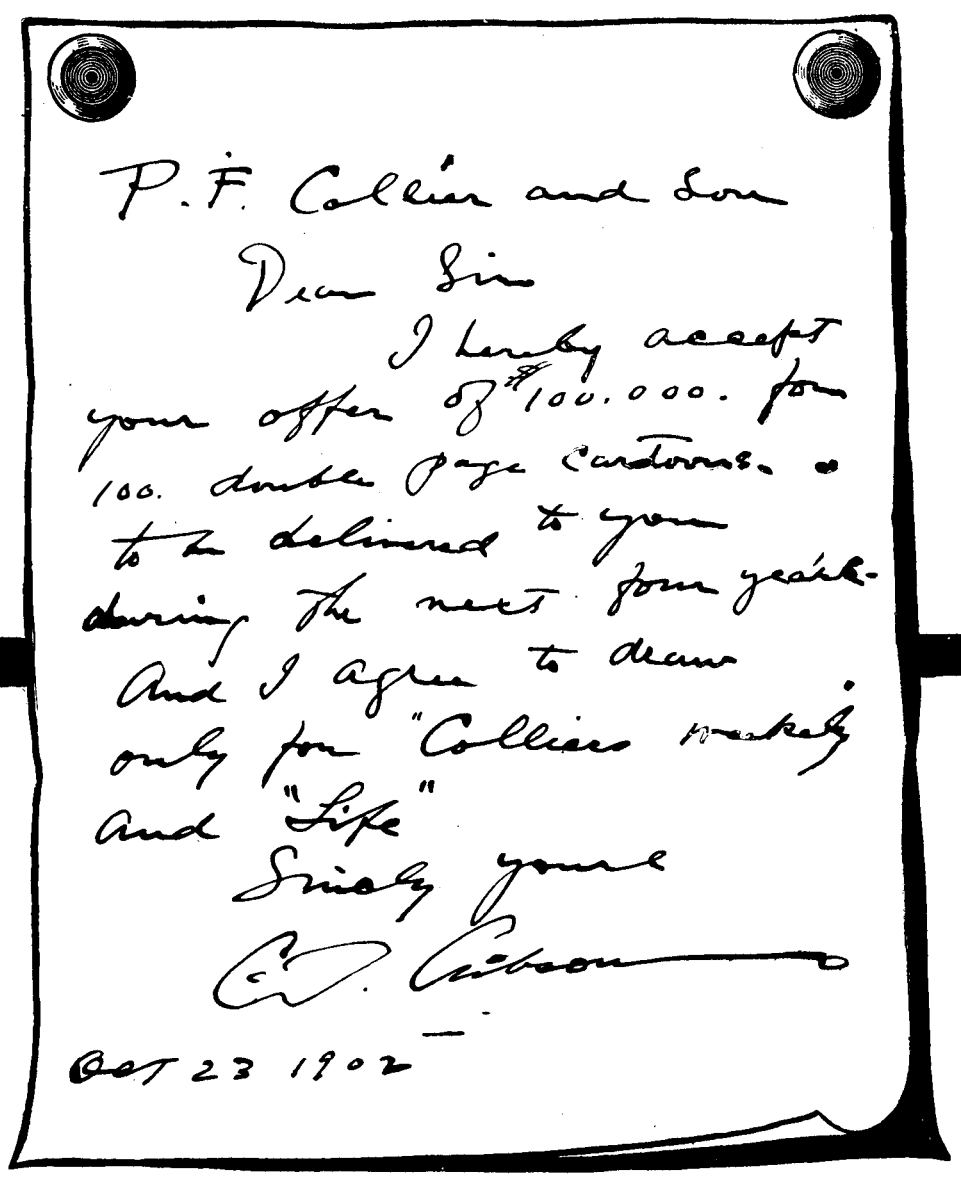
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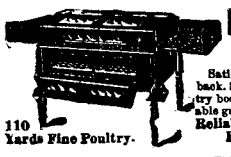

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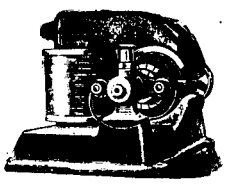

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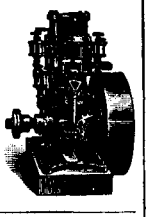

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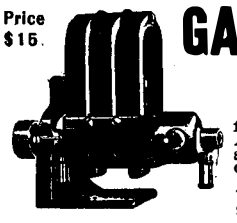

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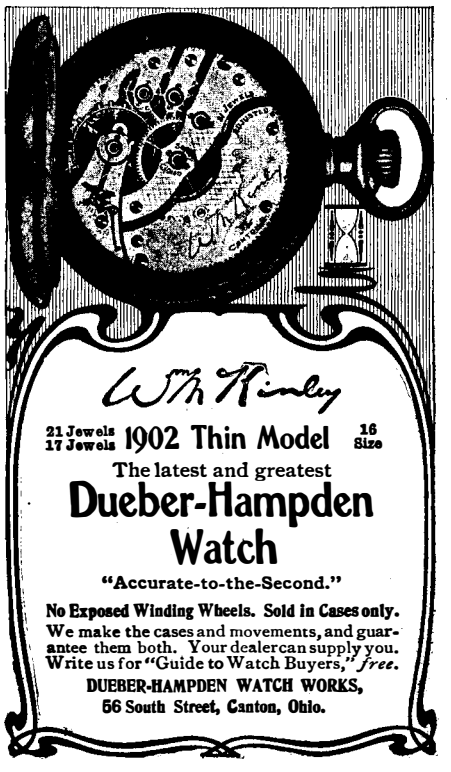

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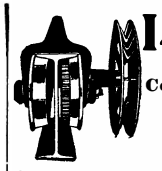
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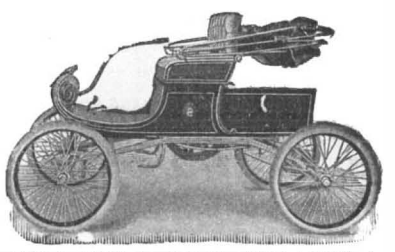

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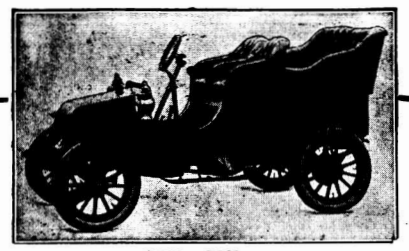

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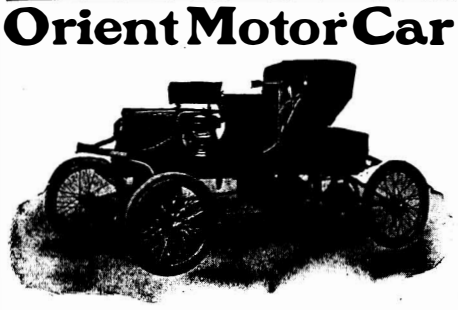

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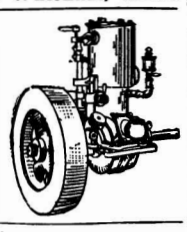

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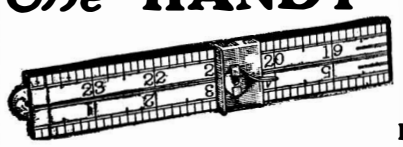

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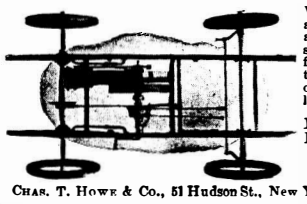

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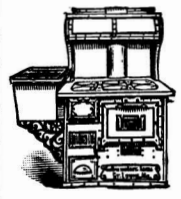

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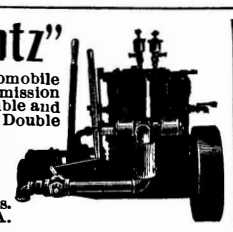

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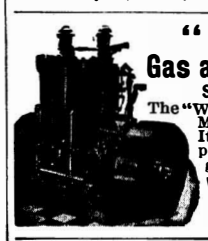

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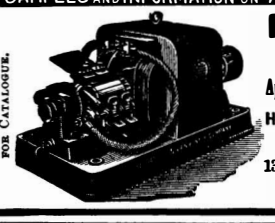

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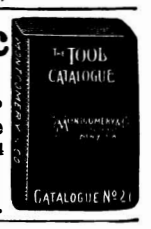

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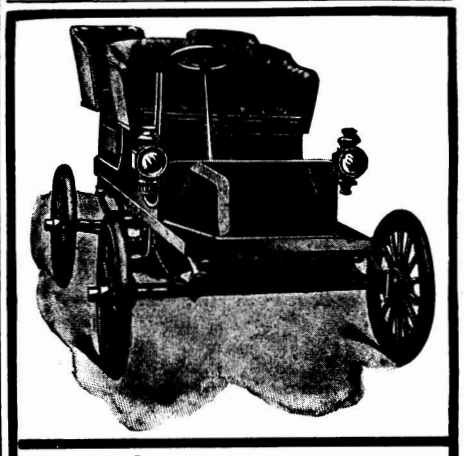

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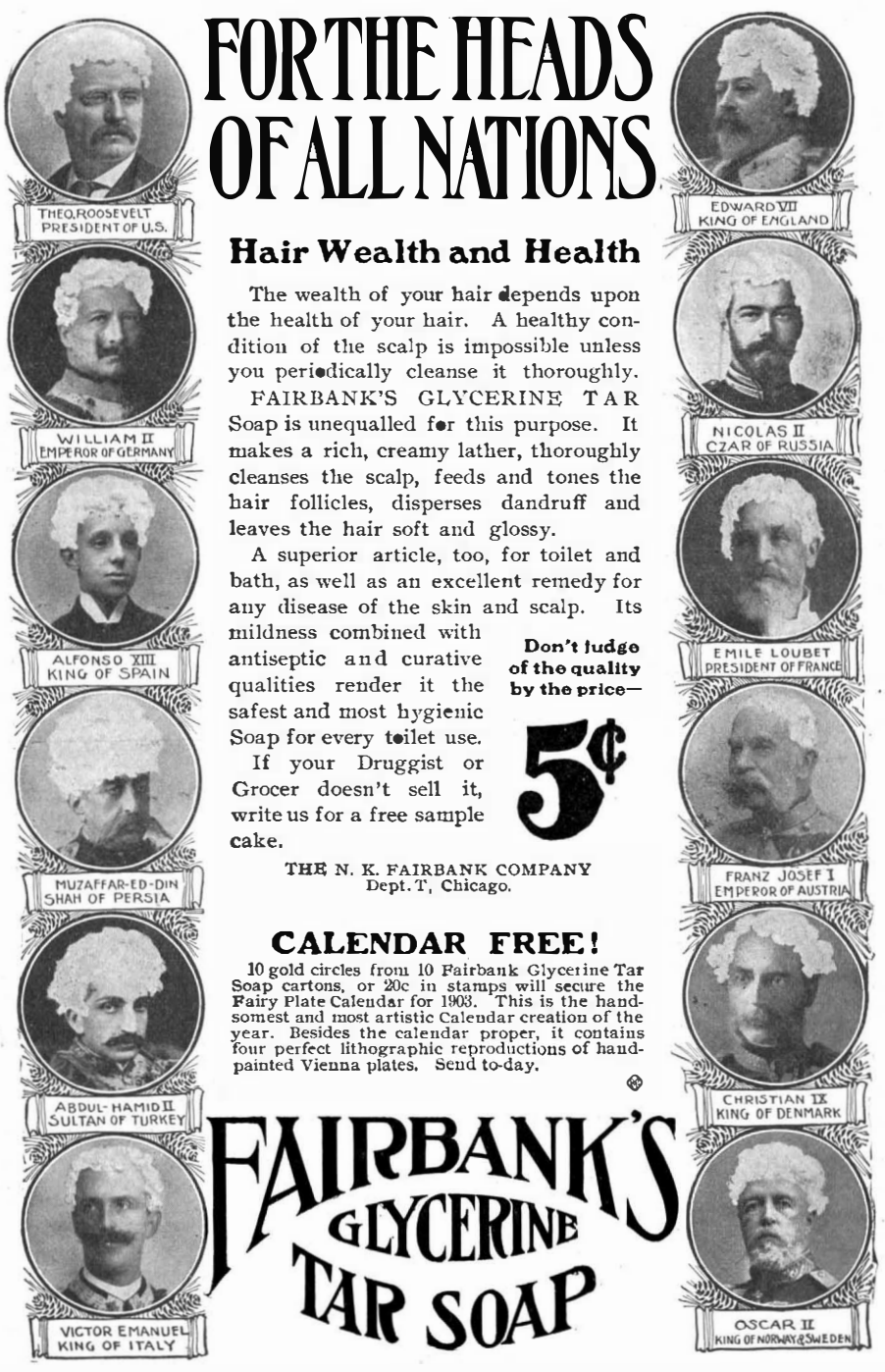
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